NUTRITION IN PREGNANCY, LACTATION AND INFANCY

Unit 2

OBJECTIVES

This chapter briefly discuss about:-

- Physiological changes during pregnancy
- Nutritional requirments of pregnant and lactating women, consequences of malnutrition during pregnancy and lactation.
- Nutritional needs of infants, advantages of breast milk, artificial feeding, weaning and problems of weaning.

Pregnancy and lactation are the most stressful periods in the life of a woman. Adequate nutrition before and during pregnancy has greater potential for a long term health impact than it does at any other time. Studies in human and animals indicate that nutrition during pregnancy influences not only the normal development of the foetus and immediate help of the new-born infants, but there are now also compelling data that nutrition during pregnancy influences the subsequent morbidity and mortality of the off - spring when they are grown adults. Current recommendation for the nutrition during pregnancy stress the importance of a proper pattern of weight gain and an adequate intake of calories, proteins, vitamins and minerals to allow for optimal foetal development and the preservation of maternal health.

2.1 Nutrition in pregnancy

A woman who has been well nourished before conception begins her pregnancy with reserves of several nutrients so that the needs of the growing foetus can be made without affecting her health.

2.1 a. Physiological changes during pregnancy

- Total plasma volume in a non - pregnant women averages 2600 ml. By 34 weeks it is about 50% greater than it was at conception.
- Increased blood volume produces a high glomerular filtration rate. It appears that the renal tubules are unable to adjust completely and a percentage of nutrients that would have been reabsorbed in the non - pregnant women are excreted in the urine.

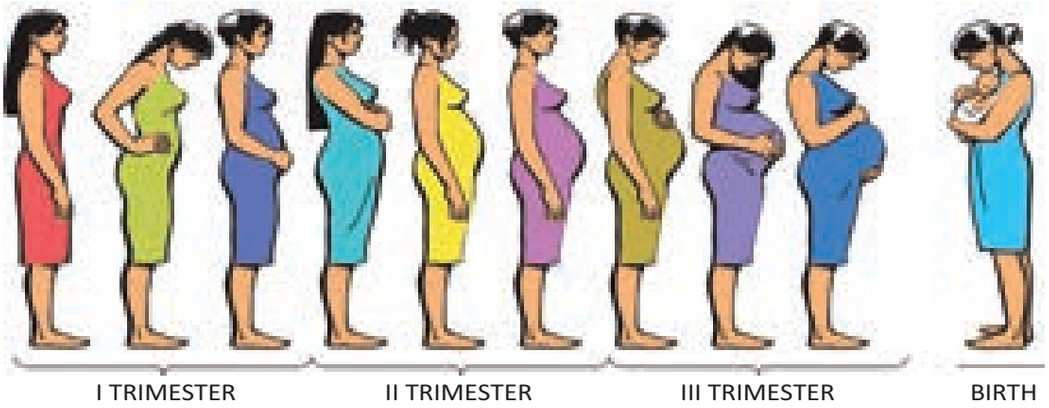

Fig 2.1 Stages of pregnancy

- There is a decreased ability to taste saltiness. This may in fact, be a physiologic mechanism for increasing salt intake.
- The ability to excrete water is lowered and oedema in the legs and ankle is common and normal.
- Gastrointestinal motility diminishes, to allow for increased absorption of nutrients. This often results in constipation.
- A relaxed lower oesophageal sphincter can cause regurgitation and heart burns.
- Increased progesterone level relaxes the uterine muscle to allow expansion with foetal growth.
- High oestrogen levels during pregnancy promote a gynaecoid type of fat distribution.

2.1 b. Role of Placenta

The placenta is the principal site of production for several hormones responsible for regulation of foetal growth and development of maternal support tissues. It is also involved for exchange of nutrients, oxygen and waste products.

2.1.1 Weight gain during pregnancy

A healthy women gains an average weight about 11-13 kg during pregnancy. About 900 to 1800g is an average gain during the first trimester. Thereafter 450 gram/ week during the remaining of the pregnancy is usual.

The overweight women (20 % or more above the ideal weight for height and age) entering pregnancy have increased risk of complications like hypertension, diabetics, etc. Even in this group it is not advisable to restrict weight gain by limiting calories from food intake. Hence obese women should receive atleast 30 kcal/ kg body weight and are advised to reduce weight by exercise rather than diet restriction. While low weight gain in pregnancy is associated with a higher incidence of pre - maturity and low birth weight babies.

"Sharp sudden increase in weight after the 12th week of pregnancy which may indicate excessive, abnormal water retention, should be watched. Weight reduction should never be undertaken during pregnancy. Excessive weight gain places an extra strain on the organs and increase the incidence of toxaemia."

DO YOU KNOW? The uterus enlarges up to 500 times its normal size? It can go from a couple of ounces to 1-2 pounds in weight. Once after delivery it gradually goes back to its original size.

Tables 2.1 and 2.2 give the components of weight gain during pregnancy and recommended weight gain based on body mass index.

Table 2.1 components of weight gain during pregnancy.

Gestation (weeks)	12	13-27	28-40
Foetus	5	1500	3000
Placenta and amniotic fluid	50	1000	1500
Maternal tissues and blood	600	6000	7000
Total weight gain	655	8,500	11,500

Source – Hytten, F. and Leitch, I. Physiology of Human Pregnancy, Blackwell Scientific Publishers, Oxford, London and Edinburgh, 1971.

Table 2.2 recommended weight gain for pregnant women based on body mass index.

Weight category based on BMI	Total weight gain (kg)
Under weight (BMI < 19.8)	12.5 – 18
Normal weight (19.8 – 26)	11.5 – 16
Over Weight (26 – 29)	7 – 11.5
Obese (>29)	6.0

Source – B.Srilakshmi.,Dietetics., New Age International Publishers.

Your heart grows! Yes, your heart organ actually enlarges while you are pregnant. It works harder and beats at a more rapid pace due to the increased volume of blood in your body. Your blood volume alone increases by 40 – 50% during pregnancy.

Due to undernourishment of the mother the baby is at an increased risk of being premature with low birth weight and development irregularities. Intrauterine nutrition is highly important for the growth of the central nervous system and kidneys of the foetus, which mature during the latter part of the pregnancy. Therefore nutrition deficits before birth can never be wholly reversed after birth.

Schematic diagram, figure 2.2 shows the relationship between maternal and foetal malnutrition.

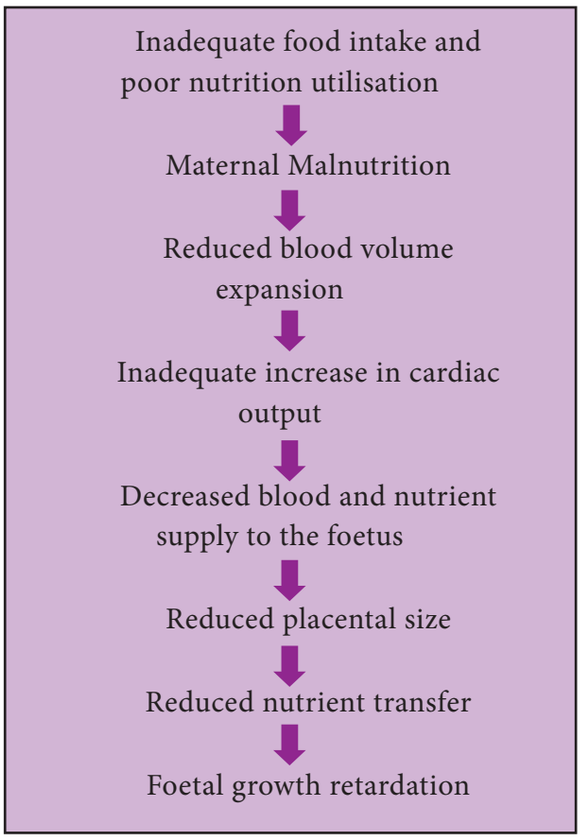

Fig 2.2 Relationship between maternal and foetal malnutrition.

2.1.2 Effects of under nutrition on the mother

a) Maternal body size

Early marriage tradition in many poor societies and pregnancy during adolescence before the genetic potential of growth is achieved, imposes additional burden which results in the poor growth of the foetus and birth of growth retarded child.

b) Multiple nutrient deficiencies.

Multiple nutrient deficiencies is due to poor diet are markedly aggravated during

Fig 2.3 Stages of foetal growth

pregnancy. The incidence of anaemia, signs and symptoms of B complex vitamin deficiency such as angular stomatitis, glossitis, tingling and numbness, burning feet are common among low socio economic group. Serum levels of many nutrients such as serum iron, folic acid, vitamin B12, riboflavin, vitamin A and bone density are significantly lower in women from low income group as compared to the well to do women.

c) Maternal mortality

Anaemia, heavy bleeding and toxaemia seems to contribute to nearly 30 - 40 % of maternal death, indicating that maternal malnutrition is a major determinant of high maternal mortality.

d) Placental function

There is an impairment in placental function due to maternal malnutrition. Earlier opinion that placenta could function normally at the expenses of maternal resources is now been a question.

Activity : 1

Conduct a survey among pregnant women and find out weight gain during trimesters.

2.1.3 Effects of maternal malnutrition on the foetus

a) Congenital malformations in the foetus

Foetal wastage is high in low- income population, one can assume that dietary deficiencies do contribute to higher incidence of congenital malformations. The incidence is much higher if mothers have suffered from viral infection such as rubella, influenza etc.

b) Birth weight

The birth weight of infant is influenced by many factors such as maternal age, parity, height, altitude, ethnic origin and socioeconomic status. Since mother's belonging to low income groups are lighter and shorter, it may be argued that the low birth weight observed in this population is an effect of maternal size, which in turn is an outcome of poor nutritional status of the mother.

c) Infant mortality

The major components of infant mortality i.e. perinatal (28 weeks of gestation to 7 days postnatal) and early neonatal (7 days - 1 month after birth) mortality, are directly related to the health and nutritional status of the mother during pregnancy. Due to high incidence of low birth weight and prematurity in poor - communities perinatal and neonatal death rates are also higher and contribute to almost 60 % of infant deaths.

d) Development of brain and mental function

The peak period of human brain growth is in the last few weeks of intrauterine and first 6 months of extra uterine life. After this, the brain growth slows down, nutritional insults during these phase can be expected to affect brain development and lead to poor mental function.

e) Delayed consequences of foetal growth retardation

In recent years, it is increasingly recognised that effects of foetal malnutrition continues into the adult age, if the infant survives. It is observed that the incidence of chronic metabolic disease like diabetes, hypertension, cardiovascular insufficiencies and cerebrovascular stroke are more common in these infant when grown into adulthood than the normal birth weight adults.

2.1.4 Nutrition requirement during pregnancy

a) Calories

Energy requirement during pregnancy is increased for maintaining the growth of the foetus, placenta and maternal tissues and for the increased basal metabolic rate (BMR). The additional energy cost of pregnancy for a 55 kg woman has been estimated to be around 80,000 kilocalories. The energy needs are evenly distributed throughout the pregnancy. Energy requirements are also influenced by the pre pregnancy body weight, physical activity and age. WHO recommends an additional 150 Kcal/day in the 1st trimester and 350 Kcal/day in the last 2 trimesters.

b) Protein

The additional protein requirement during pregnancy is mainly due to accretion of protein by the foetus, the enlargement of uterus, mammary glands, placenta, formation of amniotic fluid and storage reserves for labour, delivery and lactation which is around 1000g for the entire pregnancy. For this additional daily requirement, allowance of a good quality protein like 10g milk or egg protein per day has been suggested. The protein required for a pregnant woman is 82.2g/ day. Women who are chronically undernourished and underweight, those with infection and infestation and adolescent pregnant women, may require extra protein in the form of milk or other animal proteins and calories for repletion of tissue proteins to enable them to with stand the stress of pregnancy and lactation.

Table 2.3 ICMR recommended dietary allowances of an expectant mother 2010

Nutrient	Normal adult women	Pregnant women
Energy Kcals		
Sedentary work	1900	+350
Moderate work	2230	+350
Heavy work	2850	+350
Protein gm	55	82.2
Fats gm	30	30
Calcium mg	600	1200
Iron mg	21	35
Vitamin A		
Retinol µg or	600	800
Carotene µg	4800	6400
Thiamine mg		
Sedentary work	1.0	
Moderate work	1.1	+0.2
Heavy work	1.4	
Riboflavin mg		
Sedentary work	1.1	
Moderate work	1.3	+0.3
Heavy work	1.7	
Niacin equivalent mg		
Sedentary work	12	
Moderate work	14	+2
Heavy work	16	
Pyridoxine mg	2.0	2.5
Ascorbic acid mg	40	60
Dietary folate µg	200	500
Vitamin B12 µg	1.0	1.2
Magnesium mg	310	310
Zinc	10	12

c) Minerals

i) Calcium

Calcium requirement suggested by ICMR for an adult woman is 600mg / day. Requirement increases during pregnancy to 1200 mg/ day. Increased intake of calcium by mother is highly essential, not only for the classification of foetal bones and teeth but also for protection of calcium resources of mother to meet the high demands during lactation. Dairy products are a primary source of calcium. Green leafy vegetables like agathi and gingelly seeds also contribute to calcium.

ii) Iron

Normal iron requirement for an adult woman is 21 mg/ day, ICMR requirements during pregnancy is 35 mg / day. Additional iron requirement during pregnancy is computed from iron needs for foetal growth (250 mg), expansion of maternal tissue including the red cell mass during pregnancy, (400mg) the iron content of placenta and the blood loss during parturition (250mg). There is, however, saving (150 mg) due to cessation of menstruation (amenorrhea). The iron absorption is better when taken with Vitamin C rich fruits i.e. fruits like 'amla' (Indian gooseberry), guava and other citrus fruits. Liver, dried beans, dried fruits, green leafy vegetables, eggs, enrich serials and iron fortified salt provide additional sources of iron.

d) Vitamins

i) Vitamin A

Normal Requirements of ß - carotene for an adult woman is 4800 µg and during pregnancy it is increased to 6400 µg. Same level is suggested during pregnancy. Liver, egg yolk, butter, dark green and yellow vegetables and fruits are good sources of vitamin A.

ii) Vitamin D

Vitamin D is a highly essential as it enhances the maternal calcium absorption. Its active form calcidiol and calcitriol cross the placenta with ease and play an important role in calcium metabolism of the foetus. Maternal deficiency of vitamin D results in neonatal hypocalcaemia and hypoplasia.

iii) Thiamine, Riboflavin, Niacin, Pyridoxine

Since the requirements of B complex vitamins like thiamine, riboflavin, niacin

are related to calories, the additional amount recommended during pregnancy and lactation are based on additional calories. Thus, the additional amounts (mg) recommended during pregnancy is 0.2 mg thiamine, 0.2 mg riboflavin, and 2 mg niacin equivalents. The additional amount of pyridoxine recommended is 2.5 mg during pregnancy as well as lactation.

iv) Folate

During pregnancy there is considerable increase in the demand for folates, which are required for DNA synthesis in the rapidly growing tissue. The greatest significance of folic acid and its potential influence on pregnancy outcome is its role in preventing neural tube defects, such as **spina bifida**. Folic acid deficiency can lead to anencephaly. Recommended daily intake for adults is 100µg and for pregnant women 400µg. To reach this level, the consumption of green vegetables should be increased and additional folate supplements should be given even in pre pregnancy stage and throughout pregnancy.

v) Vitamin B 12

The recommended intake of vitamin B12 for adults is 2µg per day. During pregnancy, additional amount is required for haemopoiesis and liver storage for the foetus and subsequent secretion in milk. During the later half of pregnancy, the requirement of vitamin B12 increases to 3.0µg per day to provide for foetal storage of 50 - 100µg.

2.1.5 Dietary guidelines

Usually a diet containing 3 cups of milk or its equivalent, 2 servings of meat, fish, poultry, eggs, or a source of complete protein, a dark green yellow vegetables and generous serving of citrus fruits will provide a foundation for a nutritionally adequate diet. Between the 6th to 14th week of pregnancy 75% women suffer from nausea which inturn affect the appetite. The conception of small and frequent meals at regular intervals are helpful to many women. This pattern is also very helpful in the later part of pregnancy

when discomfort is experienced after last meal due to overcrowding by foetus in the abdominal cavity. Plenty of water, at least 4 to 6 glasses in addition to what is contained in the form of milk and other beverages should be taken daily throughout pregnancy. It is recommended that, pregnant women limit their intake to two cups of caffeine containing beverages per day like tea, coffee and chocolate.

More fibre should be included in the diet to prevent constipation which is a common problem during pregnancy. 5 - 6 servings of fruits and vegetables should be included in the daily diet. Inclusion of green leafy vegetables ensures minerals like calcium and iron. Raw fruits and vegetables are to be included in the diet to meet vitamin C and fibre requirement. Fatty rich foods, fried foods, excessive seasoning, strongly flavoured vegetables may be restricted in the case of nausea and gastric distress.

2.1.6 Dietary problems

a) Nausea and vomiting

Nausea in pregnancy may be due to nervous disturbances, placental protein intoxication or due to derangement in carbohydrate metabolism. Morning sickness of early pregnancy can be improved by small and frequent meals. Liquids may be best taken between meals instead of with food. If the condition develops to hyperemesis gravidarum, a severe prolonged persistent vomiting, peripheral parenteral nutrition and careful oral

feeding is essential. Fruits and vegetables can be given, fat rich foods, fried foods, exercise seasoning, coffee in large amounts and stronger flavoured vegetables may be restricted or eliminated if the nausea persists.

b) Heart burn

Increase progesterone production, cost decreased tone and mobility of the smooth muscles of gastrointestinal tract. This leads to regurgitation. Heartburn is a common complaint during the later part of pregnancy. This is usually, can be relieved by small and frequent meals limiting the amount of food consumed at one time and drinking fluids between meals. Sitting upright after meals at least for 3 hours before lying down may also help.

c) Constipation

The pressure of the enlarging uterus on the lower portion of the intestine, in addition to the hormonal muscle relaxant effect of placental hormones on the gastrointestinal tract may result in constipation. Increased the fluid intake and use of natural laxative foods such as whole grains, dried fruits and other fruits, vegetables that are rich in fibre, juices usually induce regularity.

d) Oedema

Mild, physiologic oedema is usually present in the extremities in the third trimester. Swelling of lower extremities may be caused by the pressure of the enlarging uterus on the veins returning fluid from the legs. The normal oedema requires no sodium restriction or other dietary changes.

e) Pica

Consumption of non - food items like laundry starch, ice cubes or clay is called pica. It occurs more often during pregnancy than at any other time. A deficiency for essential nutrient, such as calcium or iron, results in the eating of non - food substances that contain these nutrients

Activity : 2

Suggest some fibre rich diets to avoid constipation during pregnancy.

2.1.7 Practices incompatible with pregnancy

Besides malnutrition, a variety of lifestyle factors can have adverse effects on pregnancy and some may teratogenic. People who are planning to have a children can make the choice to practice healthy behaviours.

a) Alcohol

Alcohol consumption during pregnancy can cause irreversible mental and physical retardation of the foetus. Foetal alcohol syndrome (FAS) of the leading causes of mental retardation is the only one that is totally preventable.

b) Medicinal drugs

Drugs other than alcohol can also cause complication during pregnancy, problems in labour, and serious birth defects. For this reason pregnant women should not take any medicines without consulting their physician.

c) Illicit drugs

The recommendation to avoid a drugs during pregnancy also includes illicit drugs, of course. Unfortunately, use of illicit drugs such as cocaine and marijuna, is common among some pregnant women. Drug of abuse, such as cocaine, easily cross the placenta and impact foetal development further more they are responsible for preterm birth, low birth weight infant, perinatal death, and sudden infant death. If these new-born's survive their crisis and behaviour at birth are abnormal, and their cognitive development later in life is impaired.

d) Smoking and chewing tobacco

Smoking cigarettes and chewing tobacco at any time exert harmful effects, and pregnancy dramatically magnifies the hazards of these

practices. Smoking restrict the blood supply to the growing foetus and soulmates oxygen and nutrient delivery and waste removal. Smokers tend to eat less nutritious food during their pregnancy than do non-smokers which in turn impairs foetal nutrition. A positive relationship exist between sudden infant death syndrome (SIDS) and both cigarette smoking during pregnancy and postnatal exposure to passive smoke. Smoking during pregnancy may even harm the intellectual and behavioural development of the child later in life. Infants of mother who chew tobacco also have lower weight and higher rates of foetal death than infants born to women who do not use tobacco.

e) Environmental contaminants

Infants and young children of pregnant women exposed to environmental containment such as lead and mercury show signs of impaired cognitive development.

In order to prepare body for birth, it produces a hormone called relaxin which softens your ligaments. This softening helps your baby pass through your pelvis during labour.

f) Vitamin mineral megadoses

The pregnant women who is trying to eat well may mistakenly assume that more is better when it comes to vitamin - mineral supplements. This is simply not true, many vitamin are toxic when taken in excess, and the minerals are even more so, some at levels not far above recommendations.

g) Caffeine

Caffeine crosses the placenta, and the developing foetus has a limited ability to metabolize it. For this reason, pregnant women may wonder whether they should give up coffee, tea, and colas because of their caffeine contents. Research studies have not proved that caffeine (even in high doses) causes birth defects in human infants (as it does in animal), but limited evidence suggests that moderate - to - heavy use may lower infant birth weight.

h) Weight loss dieting

Weight loss dieting, even for short periods, is hazardous during pregnancy. Low - carbohydrate diets or fats that causes ketosis deprive the foetal brain of needed glucose and may impair its development. Such diets are also likely to lack other nutrients vital to foetal growth. Regardless of prepregnancy weight, pregnant women should never intentionally lose weight.

i) Sugar substitutes

Artificial sweeteners have been extensively investigated and found to be safe for use during pregnancy. (Women with phenylketonuria should not use aspartame). It would be prudent for pregnant women to use sweeteners in moderation and within an nutritious and well balanced diet.

Activity : 3

Prepare a low cost iron rich diet for a pregnant women

2.2 Nutrition in lactation

Nutritional link between the mother and child continues even after birth. Born baby depends for some period solely on breast milk for their existence. During the first two or three days after birth, a small amount of Colostrum is secreted. The amount of milk produced corresponds either to the productive capacity of the mother or the nutritional requirements of the infant. Many factors influence milk production, nutritional status being one of them. Nutritional requirements

of the mother during lactation mainly depends on the volume of milk produced, duration of lactation, and the composition of breastmilk to meet the requirements of the growing infant.

2.2.1 Role of hormones in milk production

Sucking by infant initiates hormonal changes that leads to milk production and let down reflex, which releases milk as shown in figure 2.4

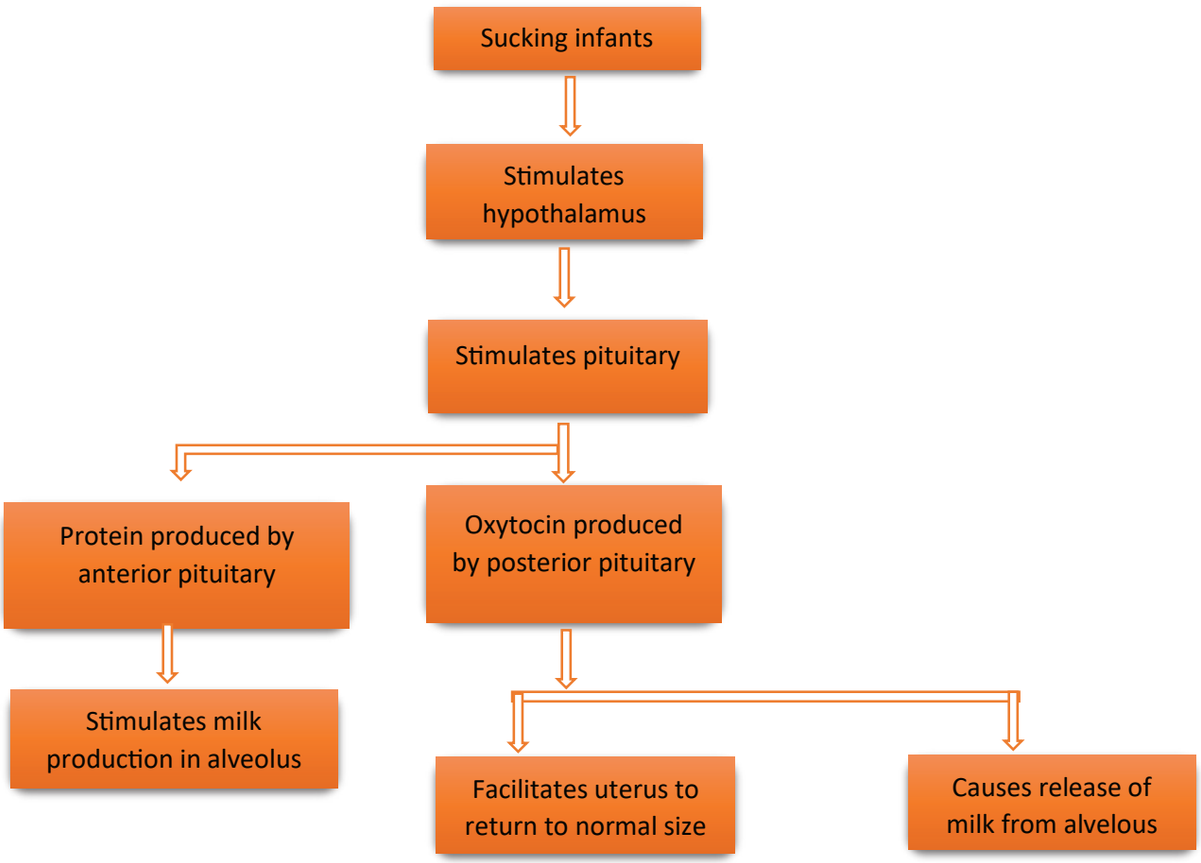

Fig 2.4 process of stimulation of milk production

This process of lactation is controlled by various hormones. The source of the hormones and their function is summarised in table 2.4

Table 2.4 Hormonal control of lactation

HORMONE	SOURCE	ACTIVITY
Oestrogen	Ovary and placenta	Stimulates breast development during pregnancy
Progesterone	Ovary and placenta	Stimulates breast development during pregnancy
Prolactin	Anterior pituitary gland	Simulates milk production
Oxytocin	Posterior pituitary gland	"Let down" reflex: Smooth muscles surrounding the alveoli of the nipples contract to allow the release of milk.

2.2.2 Nutrient requirement during lactation

a) Energy

The additional energy needed for lactation is drawn from maternal adipose tissue stores lay down during pregnancy. Depending on the adequacy of the stores, additional energy input may be needed in the lactating women's daily diet. This is the reason nutrition expert committee (2010) prescribed additional calories 600 and 520 respectively for 0 - 6 months and 7 to 12 months.

b) Protein

During lactation, protein requirement has been computed on the basis of secretion of protein in milk. An additional daily intake of 22.9 g for the first 6 months and 15.2 g during 7-12 months of lactation is prescribed. If energy or protein is lacking, there will be a reduction in milk volume rather than in milk quality.

c) Minerals

i) Calcium

The increased amount of calcium that is required during gestation for mineralization of the foetal skeleton is now diverted into the mother's milk production. Both during pregnancy and lactation 1200 mg has been prescribed by ICMR. The retention of dietary calcium in lactating women is about 30 %, hence an extra amount of 600 mg is prescribed. About one litre of milk or milk products should be given to lactating mother to meet 1200 mg of calcium.

ii) Iron

The iron requirement during lactation is 25 mg per day. The baby is born with the relatively large reserve of iron since milk is not a good source of iron. A good allowance of iron in the mother's diet during lactation does not convey additional iron to the Infant. Iron requirement during lactation is the sum

Foods That Boost Milk Production

of the requirement of the mother and that required to make up the iron lost in breast milk. Since there is an amenorrhea during lactation the basal requirement will be same as in adult women 14µg/kg.

d) Vitamins

i) Vitamin A

The quantity of retinol present in 680 ml of human milk is 50µg, so the ICMR recommends an additional allowance of 350µg of retinol. This can be achieved by including liver, fish liver oil, egg yolk, milk and green leafy vegetables in the diet.

ii) Thiamine, Riboflavin, Niacin

Thiamine content of mother's milk depends on mother's diet. Dietary allowances for thiamine for lactating mothers is 0.5 mg/1000 kcal and their daily requirement is computed on the basis of their energy allowance. The additional allowance recommended by ICMR (2010) on the basis of additional calorie allowances 0.3 mg for 0 to 6 months lactation and 0.2 mg for 7-12 months.

Additional allowance of riboflavin corresponding to the increased energy allowance would be 0.3 mg. RDA for riboflavin during lactation is computed on the basis of 0.6 mg 1000 kcal. If the diet meets the requirement of protein and calcium the requirement of riboflavin would be definitely met. Milk is not only a good source of calcium but also a good source of riboflavin.

The nicotinic acid content of the breast milk of Indian women ranges between 100 and 150µg per 100ml. The amount lost in milk is between 0.9 and 1.2 mg per day. The dietary allowances for niacin is 6.6 mg niacin equivalents per 1000 kcals.

iii) Folic acid

The folic acid content of breast milk secreted by Indian women is 1.6µg per 100ml.

Table 2.5 ICMR recommended dietary allowances of a lactating mother-2010

Nutrient	Normal women	Lactating women	
		0-6 months	7-12 months
Energy Kcals			
Sedentary work	1900		
Moderate work	2230	+600	+520
Heavy work	2850		
Protein gm	55	77.9	70.2
Fats gm	30	30	30
Calcium mg	600	1200	1200
Iron mg	21	25	25
Vitamin A			
Retinol µg	600	950	950
Carotene µg	4800	7600	7600
Thiamine mg			
Sedentary work	1.0		
Moderate work	1.1	+0.3	+0.2
Heavy work	1.4		
Riboflavin mg			
Sedentary work	1.1		
Moderate work	1.3	+0.4	+0.3
Heavy work	1.7		
Niacin equivalent (g)			
Sedentary work	12		
Moderate work	14	+4	+3
Heavy work	16		
Pyridoxine mg	2.0	2.5	2.5
Ascorbic acid mg	40	80	80
Dietary folate µg	200	300	300
Vitamin B12 µg	1.0	1.5	1.5
Magnesium	310	310	310
Zinc	10	12	12

At the higher level, the amount of folate lost by the mother would be about 25µg a day. An additional allowance of 100µg of folate should be provided during lactation.

e) Fluid

An increase intake of fluid is necessary for adequate milk production, since milk is a fluid tissue. Water and beverages such as juices, soups, buttermilk and milk, all add to the fluid necessary to produce milk. A lactating mother should take 2-3 litres of fluid per day.

Human milk boost a baby's immune system big time helping baby fight viral, bacterial, and parasitic infections including respiratory tract infections, ear infections, bacterial meningitis, pneumonia, urinary tract infections, infant diarrhoea, common cold and flu.

2.2.3 Dietary guidelines

- "**Galactogogue"** or lactogogue act by increasing the prolactin secretion which in turn increases milk production. They also work psychologically and have a marginal effect on milk production. Sucking is the best lactogogue. The diet can include lactogogues, which stimulate the production of milk. Garlic, milk, almonds, and garden cress seeds are considered to increase the milk production in certain regions of India.
- Weight gain beyond that desirable for body size, should be avoided. When the baby is weaned, the mother must reduce her food intake in order that obesity may be avoided.
- It is better to control constipation by inclusion in the diet of raw and cooked fruits and vegetables, whole grains and an adequate amount of water than by use of laxatives.
- No food need be withheld from the mother unless it causes distress to the infant. Occasionally, tomatoes, onions, members of cabbage family, chocolate, spices and condiments may cause gastric distress or loose stools in the infant.

Activity : 4

Suggest a few recipes that promotes milk production.

2.2.4 Practice incompatible with lactation

Some substance impair milk production or enter breast milk and interfere with infant development. Some medical condition prohibit breastfeeding. This section describes these circumstances.

a) Alcohol

Alcohol easily enters breast milk, and its concentration peaks within an hour of ingestion. Infants drink less breast milk when their mother have consumed even small amount of alcohol.

b) Medical drugs

Many drugs are compatible with breastfeeding, but some medicines are contraindicated, either because they suppress lactation or because they are secreted into breast milk and can harm the infant.

c) Illicit drug

Illicit drugs of course are harmful to the physical and emotional health of both the mother and the nursing infant. Breast milk can deliver such high dose of illicit drugs as to cause irritability, tremors, hallucination and even death in infants.

d) Smoking

Cigarette smoking reduces milk volume, smokers may produce too little milk to meet their infant's energy needs. Consequently infants of breast feeding mothers who smoke gain less weight whereas infant's of those who do not smoke.

e) Caffeine

Caffeine taken during lactation may make a breastfed infant irritable and wakeful. During pregnancy caffeine consumption should be moderate say 1-2 cups of coffee a day. Larger doses of coffee may interfere with the availability of iron from the milk and impair the infant iron status.

2.3 Growth and development during infancy

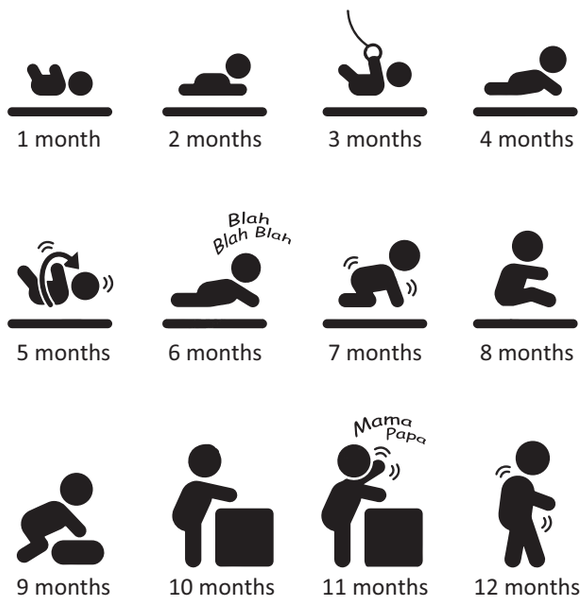

Fig 2.5 Stages of growth of an infant

Next to foetal period, the infants 1st year is the time of most rapid growth. According to WHO figures the average weight of most healthy new-born babies is around 3.2 kg. Healthy child doubles birth weight by six months. His weight becomes 3 times by the time the child is one year old. The normal birth length of 50 to 55 cm increases by another 23 to 25 cm during the first year. With increase in length the body proportions also change. At birth the child has 75% water 12 to 15 % fat. By the end of the one year the water content decreases to 60% and fat increases to 24 %. Muscles would be comparatively well developed at the end of the year. Infant have rapid heart rate, 120 - 140 per minute. But the haemoglobin level of well-nourished infant is 17 - 20 g per 100 ml. This provides a reserve for expansion of the blood circulation and adequate oxygen carrying capacity to the growing tissue during the first 4 - 6 months.

The full term infant is able to digest protein, emulsified fats and simple carbohydrates such as lactose. Salivary secretion and gastric acidity are low in infants under 3 months. Kidney reach their full functional capacity by the end of 1st year. During the first few months the glomerular filtration rate is somewhat lower and therefore the excretion of high concentration of solutes is more difficult. The increase in the number of brain cells is most rapid during foetal life and in the first five to six months after birth.

2.3.1 Nutritional requirements

a) Energy

Study reveal that basal and total energy requirement for infants are higher than adults per unit body weight. Infants require 92 Kcal / kg body weight. For one month old infant, 50 % energy intake is used for basal energy, 25 % for activity and 25 % for growth. Extremely active children may require up to 40% energy for activity. 70% of calories can be met by milk alone and rest of the calories have to be supplied by supplementary foods after six months.

b) Protein

Protein intake of a healthy infants is about 1.16 g/ kg body weight. The recommendations for infants are based on the total protein content and amino acid pattern of the average daily intake of human milk. Human milk provides all the amino acids more than the required amount needed for proper growth. Histidine, which is a non-essential amino acid for adults, is necessary for growth and maintenance of an infant. Human milk protein is 100% utilised. If calories and protein requirements are not met, infant suffer from protein energy malnutrition.

This is a range of clinical disorder resulting in severe cases to marasmus or kwashiorkor.

c) Fats and essential fatty acids

Fat intake should be 35 % E depending on the physical activity of the child from age 6 months to 2 years. Linoleic acid is the most important essential fatty acid for an infant. DHA levels in red blood cells and neural tissues help in improving visual acuity and cognitive performance of infants. Both cow's milk and mother's milk satisfy the requirements of EFA. EFA requirement of young children is 3% E which can be satisfied by 19g per day visible fat.

d) Minerals - Calcium and phosphorus

Rapid growth requires 500 mg of calcium and 750 mg of phosphorus with a ratio 1:15. Adequate prenatal nutrition supply a store of bone minerals to prevent rickets provide postnatal care furnishers a liberal supply of calcium and phosphorus. Large percentage of calcium from breast milk is retained by the infant. When sufficient calcium is not supplied to the infant, there motor development is delayed. Ca: P ratio of 1.2: 1 as in cow's milk is lower compared to 2: 1 in human milk.

i) Iron

RDA of iron for an infant is 46µg/kg bodyweight starting from 3 months. At birth, body contains 80mg/ kg. This is about 3 times that of an adult. During the first four months, blood volume doubles and concentration of iron in haemoglobin falls to about half, that present at birth.

ii) Zinc

High levels are present in colostrum and it promotes normal growth. Zinc is necessary for normal brain development.

e) Vitamins

i) Vitamin A

The RDA for retinol is 350µg. Daily intake of Vitamin A by Indian infants through breast milk is about 140µg during the first 6 months of life. After six months egg yolk is supplemented in the infant's diet.

ii) Vitamin D

It is essential for utilisation and retention of calcium and phosphorus. A good supply of vitamin D during pregnancy benefits the mother and it helps satisfactory development of the infant. The vitamin D requirement of child is 400 I.U. if there is minimal exposure to sunlight.

Table 2.6 ICMR recommended dietary allowances for infants 2010

Nutrient	Months	
	0-6	6-12
Energy Kcals	92	80
Protein gm	1.16	1.69
Fats gm	-	19
Calcium mg	500	500
Iron mg	46 µg /kg	05
Vitamin A		
Retinol µg or	350	350
Carotene µg	2800	2800
Thiamine mg	0.2	0.3
Riboflavin mg	0.3	0.4
Niacin equivalent µg /kg	710	650
Pyridoxine mg	0.1	0.4
Ascorbic acid mg	25	25
Dietary folate µg	25	25
Vitamin B12 µg	0.2	0.2
Magnesium mg	30	45
Zinc mg	-	-

Activity : 5

Collect birth weight and height of 5 infants.

2.3.2 Breast feeding

The Infant should be put to breast within half an hour after normal delivery and within 4 hours after caesarean sections. Prelacteal foods like honey, distilled water, glucose should not be given.

a) Colostrum

During the first two or three days after delivery, thick and yellowish fluid is secreted from the mammary gland. This differs from the regular milk and is called **"colostrum".** It is secreted in small quantity of about 10- 40 ml which is rich in protein. Colostrum is the first immunization to the infant. It contains an interferon like substance which possesses strong antiviral activity. Colostrum contains B12 binding protein which renders B12 unavailable for the growth of E. coli and other bacteria. It also contains antibodies against viral diseases such as smallpox, polio, measles and influenza. Enzymes like lysozyme, peroxidase and xanthine oxidize that promote cell malnutrition are found to be more in colostrum. Colostrum contains large quantities of protective substances and enhances the development and maturation of the baby's gastrointestinal track. Colostrum helps a baby pass his or her first stool.

Breastfeeding can actually reduce baby's risk of disease later in life including type 1 and 2 diabetes, Hodgkin's disease, leukaemia, obesity, high blood pressure, high cholesterol levels, ulcerative colitis, asthma, eczema and also lowers risk for sudden infant death syndrome (SIDS)

Table 2.7 Composition of Colostrum

Nutrient	Amount
Energy kcal	58
Fat g	2.9
Calcium mg	31
Phosphorous mg	14
Iron mg	0.09
Protein g	2.7
Lactose g	5.3
Carotene I.U	186
Vitamin A I.U	296

b) Transition milk

During the next two weeks, the milk increases in quantity and changes in appearance and composition. This is called **"transition milk".** The immunoglobin and protein content decreases while the fat and sugar content increases. Exclusive breastfeeding of colostrum and transition milk minimises infections related to neonatal deaths. The composition of milk changes even during the length of a single feed to exactly suit the need of a particular baby.

2.3.3 Advantages of breast feeding

Breastfeeding is not only beneficial to the infant but also to the mother. The advantages of breastfeeding can be considered under nutritional, immunological, psychological, economical and physiological and other factors.

Body is constantly making the perfect milk for baby. Milk changes its nutritional profile as baby grows (milk made for a 3 month old is different than for a 9 month old) milk can even change day to day. For example water content may increase during times of hot weather and baby sickness to provide extra hydration.

a) Nutritional benefits

The composition of human milk is best suited to the infants and provide nutrients in easily digestible and bioavailable form.

i. Carbohydrate

Human milk is the sweetest milk due to the high amount of lactose. Lactose which is present in higher levels in human milk facilitates the absorption of magnesium and calcium and favours amino acid absorption and nitrogen retention.

ii. Protein

Human milk contains 1.1 g percent protein. Human milk has 20% casein and 80 % whey proteins which constitutes lactalbumin and lactoferrin. Lactalbumin has an amino acid pattern that mainly approaches that of body protein and provides more essential amino acids than casein. Breast milk contains amino acids specific for brain development. Human milk offers a high tryptophan to neutral amino acids ratio which controls brain serotonin synthesis. Human milk also contains binding proteins of thyroxine, corticosterol, vitamin D, folate and B12.

iii. Lipids

Lipids Present in human milk are unsaturated fat, essential fatty acids, prostaglandin precursors, fat soluble vitamins, steroids, phospholipids and cholesterol. Lipids involved in the development of brain are mostly long chain polyunsaturated fatty acids. These are abundant in the breast milk. Human milk contains cholesterol and is essential for synthesis of myelin of the nervous system. Presence of chlorine, acetylcholine, phospholipid precursors and carnitine ensure optimum metabolism and brain development.

iv. Minerals

Unlike vitamins, mineral content of human milk is minimally influenced by mother's stores and immediate intake of calcium, magnesium, phosphorus, iron, copper, zinc, sodium and potassium. Minerals in the breast milk are largely protein bound and balance to enhance bioavailability. Calcium content in human milk is 28 mg and calcium phosphorus ratio of 2:1 in human milk is favourable. Breast milk ensures better oxygen saturation and increases the bioavailability of trace elements like copper, cobalt, selenium, iron and zinc.

v. Vitamins

Breast milk contains more vitamin A, C and E than cow's milk. Breast milk contains water soluble vitamin D along with fat soluble fraction which protects against rickets. riboflavin, pyridoxine and B12 content of human milk are also related to the dietary intake of mother. Heat liable vitamins like thiamine and ascorbic acid are completely available in human milk. Breast fed infants receive about 25 -30µg of folate daily, most of which is available for absorption.

b) Hormones and growth factor benefits

Breast milk is so rich source of hormones like thyroid stimulating hormone (TSH), thyroxin, parathyroid hormone, corticosteroids, calcitonin, erythropoietin, oxytocin, growth hormone releasing factor, insulin and prolactin. It contains growth regulating factors, growth promoting factors and growth modulators.

c) Immunological benefits

These factors are present in colostrum as well as in matured milk.

i. Macrophages

Human milk contains macrophages. They contribute immunity in two ways: (a) They engulf and digest bacteria. (b) These cells synthesize complement, a protein involved in establishing immunity to infectious organism.

ii. Lymphocytes

Lymphocytes are the white blood cells responsible for mediating most aspects of the immune system, with its ability to attack a wide range of infectious microorganisms. Human milk contains T and B lymphocytes.

iii. Immunoglobulins

Immunoglobulin are the difference in proteins that include all types of antibodies. Immunoglobulin are resistant to the acidity for the stomach.

iv. Lactoferrin and Vitamin B12 binding protein

Lactoferrin is an iron containing protein found both in colostrum and mature milk. It's in which the growth of staphylococcus organism and E coli by tying iron that is needed for growth. Similarly vitamin B12 binding protein present in breast milk makes vitamin B12 unavailable to pathogens that require B12 to survive in the infant's gastrointestinal track.

v. Lactobacillus bifidus factor

It is a nitrogen containing carbohydrate in human milk. It encourages the growth of microorganism, lactobacillus bifidus and produces acetic acid or lactic acid from lactose and depresses the growth of pathogenic or disease producing organism like Escherichia coli.

vi. Enzymes

Breast milk supplies enzymes like amylase, lipoprotein, lipase, bile salt, stimulated lipases, oxidases, lacto peroxidase, and leucocyte myeloperioxidase. These enzymes increase digestibility and also act as defence against microbes. Enzymes like lysozyme, peroxidase and xanthine oxidase promote cell maturation.

d) Psychological benefits

An infant derives a sense of security and belonging in the mother and child relationship from the comfort of being held than from feeding process.

Table 2.8 Calorie percentage from protein, fat and carbohydrate in human and cow's milk.

Nutrient	Breast milk	Cow's milk
Total energy (per 100 ml)	65	65
Protein	07	19
Fat	47	55
Carbohydrate	31	26

Source: Gopalan C., B.V Ramasastri and S.C Balasubramanian (2011), Nutritive value of Indian foods, NIN, ICMR, Hyderabad, India.

2.3.4 Breast feeding during illness

- Breast Feeding is to be done during illness because -
- Breast milk is the most easily digestible food for the sick baby
- Breast feeding is the best pacifier to the sick baby
- Breast milk satisfies the nutritional and fluid demands
- Breast milk offers anti-infective and immunological factors.

WORLD ALLIANCE FOR BREAST FEEDING ACTION (WABA) insists exclusive breast feeding for 6 months.

Artificial feeding

Though no milk can be real substitute for mother's milk, sometimes it is necessary to give artificial feeding. Circumstances under which artificial feeding is essential are

- The mother is suffering from serious illness, fever or infection,
- Another pregnancy intervenes during lactation

- The child is too weak to nurse or cannot because of harelip for cleft palate
- Breast milk has completely stopped or insufficient for the child
- Mother is not available to feed the child
- The mother is on anticoagulants, steroids and radioactive drugs,
- Death of the mother.

2.3.5 Weaning

Weaning begins from the moment supplementary food started and continue still the child is taken off the breast completely. The ideal time to start semi solid food is when a baby is ready to sit up, swallow and eat taste other foods, the baby's stomach is ready to digest food and the baby has good appetite and accepts food readily and there is no more activity in the child.

2.3.6 Types of supplementary foods

a) Liquid supplements

i. Milk

At about the sixth month of life the frequency of breastfeeding is reduced to three or four times per day and animal milk is substituted. Since the proportion of nutrients in animal milk differs from the human milk, the cow's milk is diluted with boiled and cooled water in the proportion of 2: 1 for the first feeds. The amount of water is gradually reduced so that in the course of a few weeks the baby receives undiluted animal milk. Two feeds, with 225 ml of milk per feed is an ideal replacement. Sugar can be added for taste and it to increase calories.

ii. Juice of fresh fruits

Oranges, tomatoes, sweet lime, grapes, serve to supplement the protective nutrients not present in sufficient amounts in breast milk as well as in animal milk. It is advantages to start feeding small quantities of fresh fruit juice even in the 3rd or 4th month of life.

iii. Soup from green leafy vegetables

In case fresh fruits are not available, green leafy vegetables may be used as an alternative. Strained soup can be given in the beginning with unstrained soup later on

b) Solid supplements

Mashed food is started around the 7th or 8th month of life. Around this time, the infant is already receiving animal milk, fruit juice or vegetable soup and fish liver oil.

i. Cereal and starchy gruels

To meet the increasing demands of calories and protein, well-cooked mashed cereal like rice, rice flour, rice flakes and ragi flour mixed with milk and sugar can be given. Addition of a small amount of vegetable oil to the porridge makes it less glutinous increasing the energy density.

ii. Vegetables

Cooked, Mashed vegetables like potato, green leafy vegetables and carrots can be introduced to get vitamins and minerals and colours in the diet

iii. Fruits

All fruits, with the exception of banana which is mashed, must be stewed and sieved for one year old baby. Thereafter, it is given simply stewed, with the addition of little sugar and lime juice for favour.

iv. Non vegetarian foods

A small amount of hard boiled yolk of egg is given to start with and if the infant tolerates, the amount maybe gradually increased to a complete yolk of an egg. Yolk is a good source of vitamin A, iron and protein. Soft custard is also a suitable way in which to introduce egg yolk.

v. Pulses

Well cook pulses along with cereals in the form of kichidi / pongal can be given or can be made into porridge. Pulse and meat preparation can be given alternate days.

2.3.7 Points to be considered while introducing weaning foods

- Introduce only one food at a time
- Allow the infant to become familiar with the foods before trying to give another
- Give a very small amounts of any new food at the beginning, for example, one teaspoon full or less.
- At first strained fruits, vegetables and cereals are given.
- Variety in choice of food is important
- If, after several trials, the baby has an acute dislike for a particular food, omit that item for a week or two and then try again.
- Food should be given between breast feeds.
- Give freshly prepared food
- By one year, the infant can be given family diet, modified, in small quantities but at frequent intervals in addition to milk. The best indication of adequacy of the diet is the growth pattern of the child.

2.3.8 Low cost supplementary foods

Indian mothers wean infant into the traditional adult diet because of their ignorance of low cost weaning foods and also because of in capacity to buy expensive commercial foods.

Table 2.9 Low cost supplementary foods

Name of the product	Composition
Indian multipurpose food (C F T R I)	Low fat groundnut flour and Bengal gram flour (75:25) fortified with vitamins A and D, B1 B2 and calcium carbonate. Contains 40 percent protein.
Malt food (C F T R I)	Cereal malt, low fat groundnut flour and roasted Bengal gram flour (40:40:20) fortified with vitamins and calcium salts. Contains 40 percent protein.
Supplementary food (NIN)	Roasted wheat flour, green gram flour, groundnut, sugar or jiggery.(30:20:8:20). Contains 12.5 percent protein.
Win food (Gandhigram Rural Institute)	Pearl millet, green gram dal, groundnut flour and jaggery. (50:15:25:25). Contains 20 percent proteins.
Amutham	Rice flour, ragi flour, Bengal gram flour, sesame flour, groundnut flour and jaggery. (15:15:15:10:10:25). Contains 14 percent proteins.
Poshak	Cereal (wheat, maize, rice or jowar) pulse (chana dhal or green gram dhal) and oil seed (groundnut) and jaggery. (4:2:1:2).
Kerala Indegenous Food. (KIF)	Tapioca, Bulgar wheat and groundnut. (25:50:25).

2.3.9 Foods to omit

Concentrated sweets, including baby food "desserts", have no place in an infant's diet. They convey no nutrients to support growth, and the extra food energy can promote obesity. Canned vegetables are also inappropriate for infants, as they often contain too much sodium. Honey and corn syrup should never be fed to infants because of the botulism. Infants and even young children cannot safely chew and swallow popcorn, whole grapes, whole beans, hard candies and nuts; they can easily choke on these foods, a risk not worth taking.

SOME INTRESTING FACTS ABOUT INFANTS

- When baby is born their hearing isn't 100% up to par. There is still of fluid which tends to impair somewhat they are able to recognise is this sound of mother's voice. They respond to this sound above all others.
- They may cry a lot but the fact of matter is new born babies don't shed tears! Although the tear ducts and glands are working, they produce just enough to lubricate and protect the babies Eyes. Look for those teardrops to start flowing between 1 and 3 months.
- Since adults are so much taller and wider than a baby you are naturally assume they have more bones right?
- Wrong! Baby is born but 270 bones and by the time he reaches adulthood the number drops to 206! Reason for the loss of bones is due to the fusion of spine and skull as baby grows.
- New-born babies are very near sighted and their vision only allows them to see people and objects that are clear rest when they are within 8 to 12 inches away.

Government Schemes for pregnant and lactating women*

Tamil Nadu government in a move to provide optimal nutrition for pregnant and lactating women, the Tamil Nadu government is all set to increase the benefits given under Dr Muthulakshmi Reddy Maternity Benefit Scheme by ₹5,000. The cash assistance being provided to pregnant mothers under Dr Muthulakshmi Reddy Maternity Benefit Scheme is being further enhanced to ₹18,000 from ₹12,000, said state health department officials. The new guidelines are under process to allot ₹18,000 along with revised nutrition programmes under the scheme. The financial aid of ₹12,000 was being given in three instalments (₹4000) for pregnant women aged 19 years or more on conditional release and restricted for first two deliveries only. However, the conditional release is being updated coupled with new nutrition plans and is likely to be implemented in April, said public health director Dr K Kolandaisamy. Every pregnant woman below poverty line who avails all required antenatal services during pregnancy in concerned primary health centre can benefit from the scheme. Mothers who deliver in government institutions and complete immunization for the child up to third dose of vaccinations under universal immunization programme are given the cash assistance. Other conditions are being upgraded and will be implemented shortly, state health department officials. The registration of pregnant women is mandatory with the 'Pregnant and Infant Cohort Monitoring and Evaluation (PICME)' portal that generates a 12-digit 'Reproductive and Child Health' (RCH) ID number and the entries to avail the benefit can be done only for the mothers having PICME number with her during delivery. A total of 25,698 pregnant women received cash assistance of `21.76 crore under Dr Muthulakshmi Reddy Maternity Benefit Scheme in the last two years in the districts of Tamil Nadu government.

***Refers to (NOT FOR EXAMINATION).**

SUMMARY

- A whole new life begins at conception. Organ system develop rapidly, and nutrition plays many supportive roles. Maternal nutrition before and during pregnancy affects both the mother's health and the infant's growth.
- All pregnant women must gain weight. Maternal weight gain during pregnancy correlates closely with infant birth weight, which is a strong predictor of the health and subsequent development of the infant.
- Nausea, constipation, heartburn, and food sensitivities are common nutrition related concerns during pregnancy. A few simple strategies can help alleviate the discomforts.
- Lactation is an automatic physiological process that virtually all mothers are capable of doing. Most lactating women can obtain all the nutrients they need from a well-balanced diet.
- Breast milk excels as a source of nutrients for the young infants. Its unique nutrient composition and protective factors promote optimal health development throughout the first year of life.

A-Z GLOSSARY

Amenorrhea	It is the temporary or permanent absence of menstrual periods.
Anencephaly	It is the absence of a major portion of the brain, skull, and scalp that occurs during embryonic development.
Cerebrovascular stroke	A stroke occurs when the blood supply to part of your brain is interrupted or reduced depriving brain tissue of oxygen and nutrients. Within minutes, brain cells begin to die.
Caesarean delivery	A surgically assisted birth involving removal of the foetus by an incision into the uterus, usually by way of the abdominal wall.
Down syndrome	A genetic abnormality that causes mental retardation, short stature, and flattened facial features.
Foetal alcohol syndrome (FAS)	The cluster of symptoms seen in an infant or child whose mother consumed excess alcohol during pregnancy, including retarded growth, impaired development of the central nervous system and facial malformations.
Hypocalcaemia	A condition in which the blood has too little calcium.
Hypoplasia	Underdevelopment or incomplete development of a tissue or an organ.
Low birth weight (LBW)	A birth weight of 2500gms or less, indicates probable poor health in the new-born and mother during pregnancy.

Spina bifida	One of the most common types of neural tube defects characterised by the incomplete closure of the spinal cord and its bony encasement.
Toxaemia	An abnormal condition of pregnancy characterised by hypertension and oedema and protein in the urine.

Evaluation

I. Choose the correct answer

1. The total plasma volume in a non-pregnant women averages _____ ml.
   (a) 2500 (b) 2600
   (c) 2800 (d) 3000
2. A healthy women gains an average weight about _____kg during pregnancy.
   (a) 11-13 (b) 14-15
   (c) 1-12 (d) 11-15
3. Consumption of non-food items like laundry starch, ice cubes are clay is called _____.
   (a) oedema (b) heart burn
   (c) pica (d) nausea
4. _____, dieting is hazardous during pregnancy.
   (a) exercise (b) weight loss
   (c) over eating (d) yoga
5. _____ stimulates milk production.
   (a) oxytocin (b) prolactin
   (c) progesterone (d) oestrogen.

II. Short answers

1. What is the role of placenta during pregnancy?
2. Suggest some ways to overcome nausea and vomiting during pregnancy?
3. What is meant by pica?
4. Write the minerals requirement for lactating mother?
5. Write short notes on Colostrum?

III. Brief answers

1. Write briefly about the weight gain during pregnancy?
2. Write about the effects of undernutrition on the mother during pregnancy?
3. Smoking and chewing tobacco exerts harmful effects during pregnancy. Give reasons.
4. Explain Hormonal control of lactation.
5. Write the practice incompatible with lactation?
6. Write briefly about colostrum?
7. Write about the immunological benefits of breast milk?

IV. Detailed answers

1. Write in detail about the physiological changes during pregnancy?
2. Explain the need of weight gain during pregnancy?
3. Write the effects of malnutrition on the foetus?
4. Suggest a diet for pregnant mother to avoid constipation?
5. Write the nutritional requirement during lactation?
6. Explain the process of stimulation of milk production?
7. Write the types of supplementary foods?