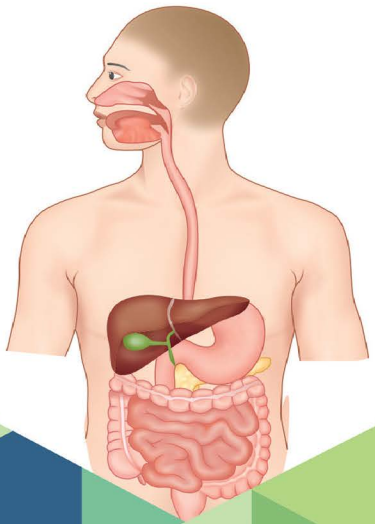
tailed information on nutrition books, visit our website www.jaypeebrothers.com, for detailed information on nutrition books, visit our website www.jaypeebrothers.co

NUTRITION

Apollo

Apollo HOSPITALS

Clinical Nutrition Handbook





Editors

Anita Jatana
Daphnee DK
Haritha Shyam
Priyanka Rohatgi
Kajal Pandya Yeptho

JAYPEE

Contents

1. **Nutrition for Preterm and Beyond** 1
   Lekha Sreedharan

2. **Nutrition in Women Health** 13
   Anita Jatana

3. **Nutritional Management for the Elderly (Geriatric Nutrition)** 28
   Champakamala C, Ashwini B

4. **Metabolic Syndrome: An Overview** 39
   Babita G Hazarika

5. **Obesity and Post Bariatric Nutrition** 51
   Priya Chitale

6. **Medical Nutrition Therapy in Diabetes** 66
   Sowmya Kalluri, Shubh Rana, Binnu Singh

7. **Nutritional Intervention in Cardiovascular Diseases** 87
   M Gayathri, Kanika Narang, Swati Srivastav

8. **Nutrition Management in Respiratory Diseases** 102
   Sunita Sahoo

9. **Medical Nutrition Therapy in Renal Diseases** 112
   Priyanka Rohatgi

10. **Nutritional Intervention and Management in Cancer** 134
    A Rajeswari

11. **Nutritional Management in Gastrointestinal Disorders** 154
    Varsha Gorey

12. **Celiac Disease** 170
    Kajal Pandya Yeptho, Tamanna Chowdhury

13A. **Medical Nutrition Therapy for Liver Transplantation** 182
    Daphnee DK

13B. **Medical Nutrition Therapy for Kidney Transplantation** 203
    Daphnee DK, Rajalakshmi P

13C. **Medical Nutrition Therapy for Heart Transplantation** 217
    Daphnee DK, Rajalakshmi P

13D. **Medical Nutrition Therapy for Intestinal Transplant** 228
    Daphnee DK

14. Enteral Nutrition for Critically Ill Adult Patients 239
Champa Mazumdar, Padmini Vijaykumar, Suhani Seth

15. Nutritional Management in Rehabilitation Setting 251
Haritha Shyam, Syeda Amena Omer

16. Bone Health and Nutrition 261
Ananya Konar, Vijayalaxmi Sirasangi

17. Sports Nutrition 272
Sandhya Singh S

18. Food and Drug Interaction 281
S Ramya

Confluence of Immunotherapy and Micronutrient: Complementary Role of Micronutrients in Immunotherapy 288
Vivek Srivastav, Anubhab Mukherjee

Enteral Tube Feeding 296
Sunil Honkalas

Index *301*

CHAPTER 2

Nutrition in Women Health

Anita Jatana

INTRODUCTION

Women form an important pillar of society and are the primary caretakers. They suffer from poor health outcomes with repercussion on them and their families. Good nutrition is very important for all but more so for women. It plays a pivotal role in the maintenance of health of women throughout life and plays a crucial role during growth, pregnancy, lactation and menopause. Likelihood of women suffering from malnutrition are higher due to their reproductive biology, lack of education, disparities and lower social status. Poor health and social status affect millions of women and adolescent girls around the world making accessibility and affordability healthcare services a challenge in the 21st Century. Globally, about 800 women die every day of preventable causes related to pregnancy and childbirth and 20 per cent of these women are from India. Leading causes of death in women in India are NCDs, led by heart attack, stroke and respiratory diseases.

Women are vulnerable to poor nutrition in all phases of life impacting their growth. About 120 million women are underweight in the developing countries and in addition to being underweight they are stunted which is a known risk factor of known obstetric complications. These women are more likely to have babies with low birthweight. The other major problem existing is anaemia. India's anaemia burden among women is widespread, consisting of non-pregnant and pregnant women and children. Data as per NFHS 2019, 68.4% children and 66.4% of women suffered from anaemia.

The nutrient reserves accumulated from childhood are vital and is even more important during these phases of physiological stress. Requirements for various nutrients, macro and micronutrients, throughout life are qualitatively similar; but there is an increased requirement quantitatively which is dependent on the rate and intensity of physiological processes taking place within the body. There is increased requirement during pregnancy and lactation with women requiring more energy, protein, vitamins and minerals to meet their increased needs. The requirements of essential nutrients are enhanced also during rapid growth of infancy, childhood and adolescence. In the elderly female the energy needs are lower, as the basal metabolic rate declines. Emphasis should be on consuming quality food which is adequate in calories and all other nutrients, with special care to include all minerals and vitamins, particularly calcium, thiamine and pyridoxine, which continue to be as essential in the elderly population as in adult women.

The Global Nutrition Report 2020 has focused on all aspects of nutrition during the

JAYPEE BROTHERS

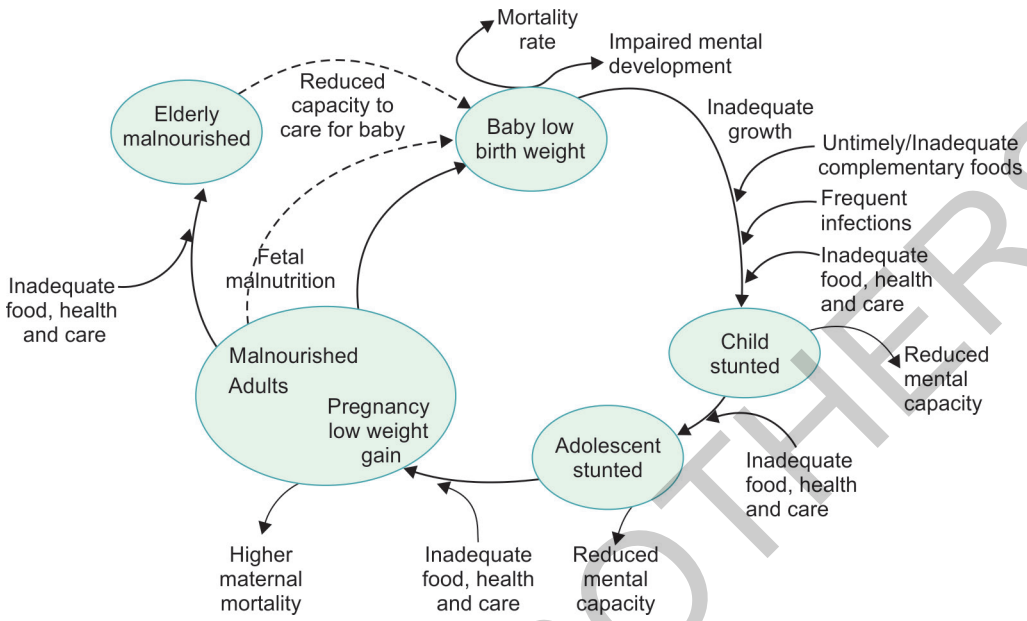


Fig. 1: Nutrition throughout the life cycle.

Source: United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition (ACC/SCN), International Food Policy Research Institute (IFPRI). Fourth report on the world nutrition situation: nutrition throughout the life cycle. Geneva: ACC/SCN; 2000.

lifecycle. Reduction of stunting in children under 5 years of age by 40%, anemia in women of the age group 19-49 years by 50%. Reduction in LBW by 30% and 50% increase in the rate of exclusive breastfeeding in the first six months. The aim is to decrease childhood wasting to less than 5% and avoid the increase in the number of overweight children.

Nutrition throughout the life cycle has been shown in **Figure 1**.

PREGNANCY

Motherhood is perhaps the happiest and most important phase in women's life. A good diet during this important phase ensures an optimum outcome. It is a unique period of opportunity when the foundations of optimum health, growth and neurodevelopment across the life span are being established. A number of nutrtional deficiencies including insufficient calories and protein intake and iron deficiency can increase the women's chance of delivering a low birth weight infant. About 20 million infants in the developing countries are born low birth weight per year which is an important determinant in child survival within first week of life and throughout infancy.

Good nutrition during pregnancy is of prime importance. It should include adequate amounts of all macro and micronutrients; in fact, it is important to focus on nutritional status of mother even preconceptually.

The growing fetus is solely dependent on the nutrition from the mother. Any nutritional deficiencies can lead to premature labor.

The quality and quantity of nourishment during each phase of development is important to reach optimum growth and be disease-free in later years.

JAYPEE BROTHERS

Nutrition Screening and Assessment during Pregnancy

Reproductive Readiness and Fertility

- The focus on preconceptual nutrition and health is essential and maintaining ideal body mass index (BMI) is important for both women and men. Being under or overweight can lead to anovulation or subfertility respectively.[1]
- Appropriate dietary interventions have shown to decrease ovulatory disorders and improve fertility.
- Suboptimal nutritional status prior to conception, with poor intake of long-chain polyunsaturated fatty acids (LCPUFAs), protein, zinc, iron and choline[2,3] are associated with increased risk of growth restricted babies or preterm births. Thus, appropriate multivitamin and multimineral intake preconceptually may confer more benefit.

Toxins

Screening mother for intake of alcohol, tobacco (including cigarettes) and other recreational drugs during pregnancy is crucial. Women can be at risk for entering pregnancy with toxic levels of mercury. These can be risk factors for miscarriages.[3]

Obesity and Endocrine Conditions

- Obesity in woman is correlated with lower rates of conception and they are at higher risk for congenital anomalies in fetus and may also have lower rates of live birth.[4]
- Obesity also affects ovulation, oocyte, embryo and endometrial development and implantation and can increase the risk for miscarriage.
- Hypothyroidism, hypertension and diabetes should be well controlled before conception.
- A healthy diet and exercise program helps in improving pregnancy outcomes.

Physiological Changes during Pregnancy

Blood Volume and Composition

There is nearly 50% increase in the blood volume by the end of pregnancy, resulting in decreased levels of hemoglobin, serum albumin, other serum proteins and water-soluble vitamins. There are increased levels of fat-soluble vitamins, lipid fractions and free fatty acids.[5,6]

Cardiovascular and Pulmonary Function

Cardiac size increases by 12% during pregnancy and there is also increase in cardiac output. Peripheral vasodilation during the first two trimesters decreases the diastolic blood pressure which returns to normal in the 3rd trimester. The pressure of the expanding uterus on the inferior vena cava leads to mild lower extremity edema. Increase in the maternal oxygen requirements and lower threshold for carbon dioxide makes the pregnant woman feel dyspneic.[5]

Gastrointestinal Function

The function of the gastrointestinal (GI) tract changes, affecting the nutritional status. Nausea and vomiting are experienced in the first trimester followed by a return of appetite. Aversions and craving to certain foods are experienced by pregnant women. Due to increase in progesterone concentration, the uterine muscles relax, allowing for fetal growth, decreasing GI motility and increasing reabsorption of water resulting in constipation. The increased pressure on stomach due to the growing uterus can cause a gastric reflux.[5]

JAYPEE BROTHERS

Renal Function

During pregnancy, there is increase in renal plasma flow with lower serum creatinine and blood urea nitrogen concentrations. There is increased excretion of water-soluble vitamins and glycosuria due to renal tubular reabsorption being less efficient during pregnancy.[7]

Placenta and Uterine Environment

The placenta is responsible for the growth of the fetus. It is also the site for the exchange of oxygen, nutrients and waste products. Any insult to the placenta compromises the nutrition to the fetus. The placenta size and cell number are of importance since a small placenta would have smaller surface area of villi which is the site of transfer of nutrients to fetus.[7,8]

Modified Needs and Rationale

Need for Nutritional Modifications during Pregnancy

Ensuring good adequate nutrition during all trimesters is of prime importance. Monitoring the weight gain during the three trimesters is important. The increased nutrient intake during this period supports adequate fetal growth.

The negative impact of maternal malnutrition (under and overnutrition) on mother and fetus has been shown in **Figure 2**.

Pregnancy weight gain recommendations: The pregnancy weight gain recommendations have been shown in **Table 1**.

The distribution of weight gain during pregnancy has been shown in **Table 2**.

Nutritional Needs: Energy Needs, Protein Needs, Vitamins and Minerals Need

The extra allowances of nutrients during pregnancy and lactation have been shown in **Table 3**.

- *Energy*: To support the metabolic demands of pregnancy and fetal growth, the energy requirements are increased during pregnancy.
- *Carbohydrates*: In order to maintain appropriate blood glucose and to prevent ketosis, carbohydrates requirement increases slightly. Complex carbohydrates such as whole grains, fruits and vegetables are preferred over simple sugars.

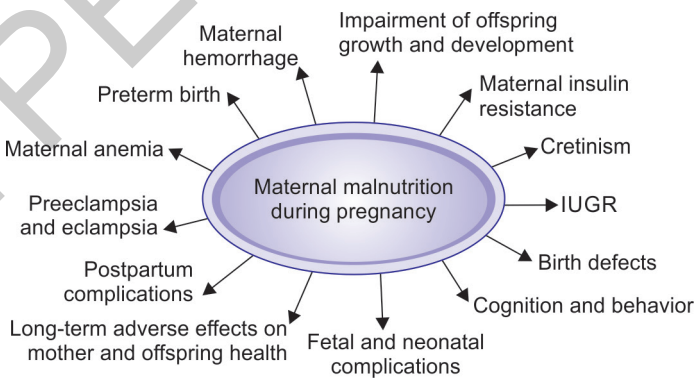


Fig. 2: Negative impact of maternal malnutrition (under and overnutrition) on mother and fetus. (IUGR: intrauterine growth restriction)
Source: Guoyao Wu, Beth Imhoff-Kunsch, Amy Webb Girard. Biological mechanisms for nutritional regulation of maternal health and fetal development, paediatric and perinatal epidemiology, 2012;26 (Suppl. 1):4-26.

JAYPEE BROTHERS

TABLE 1: Recommended weight gain.

Weight category	*WHO Asia-Pacific criteria —BMI (kg/m²)*	*IOM recommended weight gain (kg)*
Underweight	<18.5	12–18
Normal weight	18.5–22.9	11.5–16
Overweight	23–24.9	7–11.5
Obese	≥25	5–9

(WHO: World Health Organization; BMI: body mass index; IOM: Institute of Medicine)

Source: Bhavadharini B, Anjana RM, Deepa M, Jayashree G, Nrutya S, Shobana M, et al. Gestational Weight Gain and Pregnancy Outcomes in Relation to Body Mass Index in Asian Indian Women. Indian J Endocrinol Metab. 2017;21(4):588-93.

TABLE 2: Pregnancy weight distribution : A sample.

Baby weight	About 3 to 3.6 kg
Breasts	About 0.5 to 1.4 kilogram
Uterus	About 0.9 kilogram
Placenta	About 0.7 kilogram
Amniotic fluid	About 0.9 kilogram
Increased blood volume	About 1.4 to 1.8 kilograms
Increased fluid volume	About 0.9 to 1.4 kilograms
Fat stores	About 2.7 to 3.6 kilograms

Source: Mayo Clinic, Jan. 04, 2020 (https://www.mayoclinic.org/healthy-lifestyle/pregnancy-week-by-week/in-depth/pregnancy-weight-gain/art-20044360)

TABLE 3: Extra allowances of nutrients during pregnancy and lactation.[9]

Summary of Recommended Dietary Allowance (RDA) for Indians—2000																		
Age group	*Category of work*	*Body wt (kg)*	*Protein (g/day)*	*CHO (g/day)*	*Calcium (mg/day)*	*Magnesium (mg/day)*	*Iron (mg/day)*	*Zinc (mg/day)*	*Iodine (µg/day)*	*Thiamin (mg/day)*	*Riboflavin (mg/day)*	*Niacin (mg/day)*	*Vit B6 (mg/day)*	*Folate (µg/day)*	*Vit B12 (µg/day)*	*Vit C (mg/day)*	*Vit A (µg/day)*	*Vit D (IU/day)*
Women	Pregnant woman	55 + 10	+9.5 (2nd trimester) + 22.0 (3rd trimester)	175	1000	385	40	14.5	250	2.0	2.7	+2.5	23	570	+0.25	+15	900	600
	Lactation 0–6 m		+16.9	200	1200	325	23	14	280	2.1	3.0	+5	+0.26	330	+1.0	+50	950	600
	7–12 m		+13.2	200						2.1	2.9	+5	+0.17	330				

Source: Indian Council of Medical Research (ICMR). Recommended Dietary Allowances for Indians. Hyderabad, India: National Institute of Nutrition; 2010 .

JAYPEE BROTHERS

- *Protein*: Protein requirements are increased to support the synthesis of maternal and fetal tissues, hormones and neurotransmitters and is maximized during the third trimester. The deficiency of protein during this period can lead to poor fetal growth. Proteins should be included in all the meals and as in-between snacks using sources such as, milk and milk products, pulses, eggs, chicken and fish.
- *Fats*: The amount of fat in the diet would depend on energy requirements for proper weight gain. However, recommendations for omega-6 PUFA (linoleic acid) and omega-3 PUFA (alpha-linolenic acid) increase slightly. Docosahexaenoic acid, (DHA), is a long-chain omega-3 fatty acid and is integral to cellular and neural function. It is a major structural fat in the brain, retina of the eye and is a key component of the heart. DHA is especially important for optimal infant brain, eye and nervous system development. The demand is highest in the 3rd trimester and multiple maternal pathways are upregulated to insure sufficient supply. The fetus requires high amounts of maternal fatty acids **(Table 4)**.[7]
- *Calcium*: It is essential for many mechanisms such as bone formation, muscle contraction and enzyme and hormone functioning. During pregnancy, a series of physiologic changes occur, which are aimed at preserving maternal homeostasis, providing for fetal growth and development. The mineral demands of the growing fetus are largely met by increased intestinal calcium absorption. WHO recommends from 20 weeks of gestation an intake of 1.5–2.0 g elemental calcium/day divided into three doses to be taken at mealtimes until the end of pregnancy.[7] Calcium supplementation has shown benefit in terms of preventing preterm births, preeclampsia and improving both infant and maternal bone health.[7]
- *Folic acid*: Dietary folate requirement increases during pregnancy. It is required to support fetal and placental growth, DNA synthesis and maternal erythropoiesis. Low folate levels are known to be associated with miscarriages, preterm birth and low birth weight (LBW). Maternal folate deficiency in the 1st trimester increases incidence of congenital malformations, including neural tube defects (including spina bifida and anencephaly), congenital heart defects and orofacial clefts.[8]
- *Iodine*: Maternal iodine deficiency is a cause of childhood cognitive issues. Iodine is essential for the production of thyroid hormones. During pregnancy, iodine requirements increase and its deficiency in early weeks of gestation can result in cretinism in the child with the deficiency directly linked to the severity of the deficiency. Thyroid hormones are involved in neurogenesis and neuronal migration and other neuronal processes, which are linked to the effects of iodine deficiency.[8]
- *Iron*: Iron deficiency is a major health problem ranking as number one nutrition related problem. Iron deficiency with anemia (IDA) rates are as high as 77.2% among children (1–3 years of age) in rural India, with rates of deficiency among pregnant women worldwide being as high

TABLE 4: Nutrient reference values.

Pregnancy (14–18 years)	110 mg total long-chain (LC) n-3 (DHA + EPA + DPA)/day
Pregnancy (19–50 years)	115 mg total LC n-3 (DHA + EPA + DPA)/day
Lactating (14–18 years)	140 mg LC n-3 (DHA + EPA + DPA)/day

Source: Indian Council of Medical Research (ICMR). Recommended Dietary Allowances for Indians Hyderabad, India: National Institute of Nutrition; 2010 .

JAYPEE BROTHERS

as 50%. Iron deficiency during pregnancy and in infancy can cause irreversible neural issues. Fetal iron sufficiency supports neural energy metabolism, the synthesis of neurotransmitters, the development of dendrites and synapses and the onset of myelination. The dose, timing and duration of the insufficiency determine the sequelae. In a study, mothers who had anemia in the first 30 weeks of pregnancy had a higher incidence of autism spectrum disorder, attention deficit hyperactivity disorder (ADHD) and intellectual disability. When a fetus is iron deficient for extended periods of time, brain development does not proceed on a typical trajectory and outcomes are irreversible even when iron is repleted.[8]

- *Vitamin A*: Needs increase by 10% in pregnancy. It is essential for cell differentiation and proliferation as well as development of the spine, heart, eyes and ears. Mothers with vitamin A deficiency have a higher mortality rate, which may be associated with decreased immune function. Vitamin A safeguards the fetus from immune system problems, blindness, infections and death. Deficiency of vitamin A can lead to, preterm births, intrauterine growth retardation and increased risk of LBW. Most micronutrients have a wide safety margin but excess of vitamin A have been associated with cranial-facial (face, palate, ears) and cardiac birth defects.[10]
- *Vitamin D*: Maternal vitamin D deficiency has been studied for its effect on the developing fetal brain. The fetus is dependent on maternal provision of vitamin D. To date, all the research in humans has been correlational.[8]
- *Fiber*: Increased consumption of whole grains, leafy green and yellow vegetables and fresh fruits should be encouraged to provide additional minerals, vitamins and fiber. The recommendation for fiber during pregnancy is 14 g/day/1,000 kcal which can help in managing constipation which is common during pregnancy.

Complications and Nutritional Implications during Pregnancy

During pregnancy, the following complications arise which are due to changes in the hormone, decreasing the GI transit time.

Constipation and Hemorrhoids

Pregnant women complain of constipation due to inadequate consumption of water and fiber.

The pressure of the growing fetus on the pelvic floor and straining during defecation increases the risk for hemorrhoids. Encouraging increased intake of water and fiber-rich food can help in resolving the above medical conditions.

Cravings, aversions and pica: Many women have very strong cravings and aversions to certain foods during pregnancy. The most common aversions are strongly flavoured foods. Pica: Consumption of nonfood substances by pregnant women is geophagia (consumption of dirt or clay), amylophagia (laundry starch or corn starch), or pagophagia (ice). Other substances include paper, stones or gravel, soap and coffee grounds. To treat pica, the person for craving nonfood items must be analyzed. Assessment of their medical history, any symptoms or risk factors and blood tests to check for nutritional deficits should be done. The sensory-seeking behaviors and cultural beliefs surrounding nonfood items should also be addressed. Treatment options for pica include: sensory support, medication to treat underlying mental health conditions, occupational therapy and introduction of supplements. In pregnant women, pica may resolve on its own after childbirth.

JAYPEE BROTHERS

Potential complications are breaking of teeth, choking, poisoning, developing ulcers and harming the digestive system.

Heartburn: Gastric esophageal reflux is commonly experienced in the latter end of the pregnancy. The relaxation of the esophageal sphincter and the pressure of the enlarged uterus on the intestines and stomach may cause reflux. Nutritional interventions like eating smaller meals, limiting spicy foods, caffeine and carbonated beverages and sitting upright after a meal may help relieve heartburn.

Diabetes Mellitus

Gestational diabetes mellitus (GDM) is a major health problem in pregnancy. It is characterized by carbohydrate intolerance with onset or during pregnancy. It could also be a pre-existing diabetes which precipitates the carbohydrate intolerance during pregnancy. GDM is diagnosed with an oral glucose tolerance test (OGTT) administered at 24–28 weeks of gestation. Obesity and Hyperglycemia in pregnancy (HIP) are increasing to epidemic proportion. Both are associated with immediate pregnancy complication which are excess fetal growth and adiposity and subsequent risk of birth trauma. In addition to those the GDM women carry a 10-fold risk of developing Type 2 diabetes and increase risk of CVD. Appropriate nutritional modifications can help reduce the risk associated with GDM.[11] Treatment of GDM focuses on diet modification, physical activity and pharmacological management (Insulin or hypoglycemic drugs OHA) if glycemic control is not achieved with lifestyle modifications alone.

All with HIP should be screened after 6–12 weeks of delivery and continue with ongoing surveillance for diabetes even if impaired fasting glucose (IFG) is normal whereas those with abnormal levels should take appropriate treatment for prediabetes or diabetes depending on the finding.

Things to Avoid during Pregnancy

- *Caffeine*: It is suggested to decrease or quit the consumption of caffeine during pregnancy. Excess intake of caffeine may affect fetal heart rates and awake time (fetuses grow when sleeping).
- *Alcohol*: Drinking alcohol can lead to LBW, medical problems and behavior abnormalities and cause fetal alcohol syndrome.
- *Smoking*: Pregnant women should avoid smoking and secondhand smoke, since this reduces the amount of oxygen to the fetus. It also increases the risk of miscarriage, bleeding and morning sickness.
- *Exposure to chemicals*: Exposure to chemicals should be avoided especially pesticide which can easily be done by ensuring that all fruits and vegetables are washed before consumption.
- *Drugs and herbal remedies*: A pregnant woman should abstain from taking any herbal remedies or drugs without consulting the doctor as this may harm the development of the fetus.

LACTATION

When it comes to baby's nutritional needs, nothing can match the goodness of breast milk. Whether it is developing their immunity, supporting their overall growth, boosting brain development or nurturing them emotionally, breast milk has all that a baby needs. Besides that the benefits of breastfeeding are reduction in infectious diseases and infant mortality rate and also has long-terms health implications such as reduced risk of obesity, diabetes, cardiovascular disease and other metabolic diseases in adulthood.

The mother should maintain good quality nutrition intake while lactating, providing good

JAYPEE BROTHERS

nutrition for normal growth and development in the neonate.

Prevalence of early initiation of breastfeeding (proportion of children under 3 years of age breastfed within one hour of birth) increased between NFHS 4 and NFHS 5 in 10 out of 22 states (Range 0.2% to 18.6%); In rest of the states there was a decrease in prevalence (range 2.1 to 33.5%).

Prevalence of exclusive breastfeeding (proportion of under 6 months' children exclusively breastfed) increased between NFHS 4 and NFHS 5 in 16 out of 22 states (range 0.1–14.4%); highest increase was observed in Maharashtra (14.4%) In rest of the states there was a decreases in prevalence (range 1.1–26.3%); highest decrease observed in Sikkim (26.3%).

The period of golden hour:

- For all normal newborns, breastfeeding should be initiated within an hour of birth. Skin-to-skin contact with the mother should be encouraged in about 5 minutes of birth. The "Breast crawl" should be adopted.[12] This not only helps in establishing a bond between mother and child, also helps in preventing hypothermia in neonates and decreases risk of postpartum hemorrhage in mothers.
- The newborn should be kept warm by promoting Kangaroo Mother Care.[13] The benefits of kangaroo care to baby include stabilizing baby's heart rate and improving the breathing pattern. It also helps increasing in sleep time and successful breastfeeding.
- Breastfeeding can be initiated as early as 30 minutes after delivery. Colostrum should not be discarded, as was the earlier practice.
- Exclusive breastfeeding should be practiced till 6 months of age and can continue up to 2 years. Complementary foods should be introduced after 6 months in addition with breastfeeding.
- Breastfed infants should not be given additional water, since it decreases the intake of milk and increases the risk of diarrhea.
- The bifidus factor in breast milk promotes the natural gut flora which inhibits the growth of pathogens. Breast milk has immunoglobulins (IgA), lactoferrin, lactoperoxidase which protect the infant from diarrhea, upper respiratory tract infections and allergic reactions **(Table 5)**.

Benefits of breastfeeding:

- *Right nutrients, right balance*: Breast milk has the right proportions of proteins, carbohydrates, fats and other nutrients, baby needs to grow and develop.
- *Easy to digest*: Proteins in breast milk are naturally gentle and easy to digest.
- *Bioavailable iron*: Contains iron that is easy for the baby to absorb. The quantity of iron in breast milk may be low, but its bioavailability makes it significant for the baby.
- *Builds tolerance*: Helps protect the baby against early food allergies, protein intolerance and sensitivity.
- *Offers protection*: Provides natural protective antibodies and other immune-related benefits.

TABLE 5: Nutritional components of breast milk.

Energy	65 to 70 kcal/100 mL
Protein	Approximately 0.9–1.2 g/100 mL
Fat	Approximately 3.2–3.6 g/100 mL
Lactose	Approximately 6.7–7.8 g/100 mL

Source: Olivia Ballard, Ardythe L. Morrow, Human Milk Composition: Nutrients and Bioactive Factors, Pediatr Clin North Am. 2013;60(1):49–74. doi: 10.1016/j.pcl.2012.10.002.

JAYPEE BROTHERS

- *Helps digestive system*: Fosters a healthy environment in baby's digestive system.
- *Evolves*: Changes to meet the changing needs of the growing baby.
- *Creates bonding*: Provides a perfect opportunity for bonding.
- *Reduces risks*: Reduces the risk of diarrhea and respiratory illnesses.[11]

Physiological Changes during Lactation

The mammary gland grows during menarche and pregnancy which prepares the woman for the period of lactation. The levels of estrogen and progesterone drop after delivery and there is a rapid increase in prolactin secretion, setting the stage for initiation of lactation.

The physiology of milk production and the let-down reflex has been shown in **Figure 3**.

Let-down process: Movement of milk through the ducts and lactiferous sinuses starts with the secretion of oxytocin, secreted from the posterior pituitary which stimulates the myoepithelial cells of the mammary gland to contract.

External stimuli such as olfactory, visual, tactile, auditory and thought about the infant stimulates the oxytocin secretion, which can be inhibited by fatigue, anxiety, pain, emotional and physical stress.

Lactation helps the mother in the following ways:

- Promotes earlier return to prepregnancy weight
- Decreases postpartum bleeding
- Decreases risk of breast and ovarian cancers
- Decreases the chance of conception
- Promotes rapid uterine involution
- Helps in decreasing the insulin requirements in mothers with diabetes.

Modified Needs and Rationale

Nutritional Needs

- Energy requirement increases during lactation by approximately 600 kcal, making daily requirement ranging from approximately 2,200 to 3,300 kcal depending on the activity level.

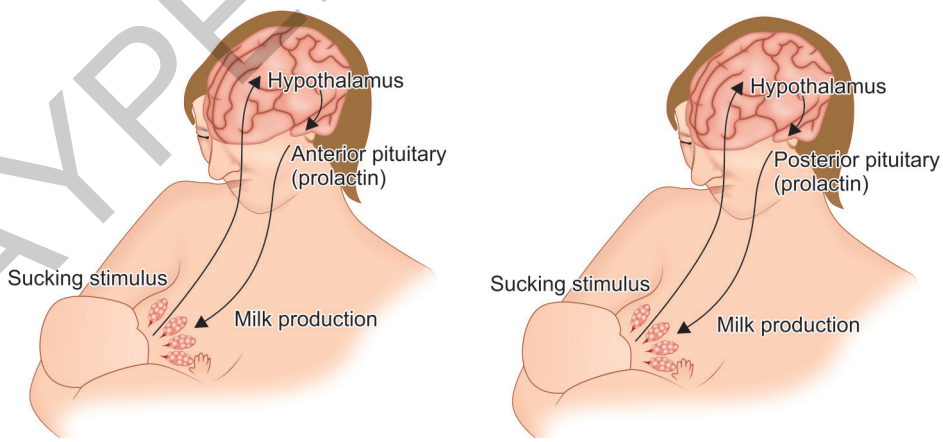


Fig. 3: Physiology of milk production and the let-down reflex.
(PRH: pituitary-releasing hormone)

Source: Kathryn R Alden. Newborn Nutrition and Feeding CHAPTER 24, Sep 16, 2016

JAYPEE BROTHERS

- Protein requirement is increased by about 17 g during lactation, enhancing the daily recommendation to about 65 g.
- Ensure intake of omega-3 fatty acids.
- Adequacy of mineral and vitamin intakes should be ensured to meet the recommended daily allowances from food or supplements as prescribed (As per ICMR recommendation - *Refer* Table 3) by the health professional. Many micronutrients requirements increase during lactation as compared to pregnancy, (*Refer* Table 3). Both water-soluble vitamins (vitamins C, B_1, B_6, B_{12} and folate) fat (vitamins A, D, K) are secreted into breast milk. In case of maternal deficiency of these vitamins there is a corresponding reduction of these in breast milk. Deficiencies of calcium, magnesium and zinc have also been seen during lactation. To avoid deficiency, it is recommended that women should continue with prenatal vitamin daily during breastfeeding. Quantity or quality of breast milk, is usually not impacted by weight reduction though anxiety, stress and smoking is linked to in decrease milk production.
- Ensure at least 2.5 L of liquid intake.
- All care should be taken to omit ingestion of toxins and non-nutritive substances from food, water and environment.

Need for Nutritional Modifications

- Good maternal nutrient stores and increasing nutrition intake during lactation ensures the quality of the breast milk.
- A diet should include a variety of foods, adequate in macro and micronutrients.
- There is an increase in prolactin levels due to early suckling stimulation and milk expression and frequency. The breast milk averages to about 8–12 breastfeeds over 24 hours in the first 2–3 weeks.
- Various factors can affect the composition of human milk like length of pregnancy, mother's diet, stage of lactation, duration and time of breastfeeding. Lactation failure is on the rise among postpartum women which is the reason for early weaning. Reasons for the rise in lactation failure are skipping breastfeeding, early introduction of infant formulas and poor latching of the baby on the breast. Other medical causes are medications, retained placenta, diseases such as diabetes and insufficient mammary tissue (hypoplasia). In some conditions, galactogogues may help in improving lactation.

The Academy of Breastfeeding Medicine (ABM) claimed that insufficient supply of breast milk was cited as one of the most common reasons to discontinue breastfeeding, with the reported prevalence ranging from 19.8 to 74.0%.[13]

Maternal Contraindications to Breastfeeding

There are a few conditions where feeding of breast milk is not advised:

- Breastfeeding is discontinued for infants with classic galactosemia.
- A mother should not breastfeed if she is suffering from active herpes or varicella but can express milk and feed instead. She should also abstain from breastfeeding if she has active untreated tuberculosis or human T-cell lymphotropic virus type 1 or 2, brucellosis, use drugs of abuse, have HIV and not being treated for it with antiretroviral drugs, or who take certain medications (i.e., antimetabolites and chemotherapeutic agents).
- Mothers acutely infected with H1N1 influenza should separate themselves from their infants while febrile, but can provide their expressed milk for feedings.

JAYPEE BROTHERS

HEALTH OUTCOMES IN INFANCY AND CHILDHOOD

The foundations of optimum health, growth and neurodevelopment across the life span are established in the first 1,000 days of life. In developing countries, prevalence of malnutrition is high, leading to significant morbidities, leading to loss of neurodevelopmental potential. Since 1980, obesity across the globe has doubled with 1.5 billion adults who are overweight and about 2.8 million die due to overweight and obesity.[14]

The major challenge worldwide is undernutrition and the negative effects of overnutrition is another health concern. Both under and over nutrition has been shown to potentially reduce brain development. About 22% of the babies born in India, each year have LBW < 2.5 kg. The major cause of which could be maternal malnutrition and anemia.

In developing countries, at least 200 million children fail to meet their full developmental potential.[14] Undernutrition, infectious disease and environmental hazards, all contribute to this loss of potential.

The fetal period and first years of life are critical for the brain development and any nutritional deficiencies in this important period can have everlasting impact. All nutrients are important for brain growth but the key nutrients are proteins, vitamin A, D, B_6 and B_{12}, iron, folate, choline and omega 3. Deficiencies of these nutrients may result in lifelong deficit in the brain functions despite nutrient repletion in later years. Timely interventions based on this above knowledge and introduction of good nutrition during this critical period can have long-term global impact.[15]

A strong correlation exists between birth size and health in later years, as shown by some studies. The increase in incidence of cardiac-related disorders, type 2 diabetes, stroke, hypertension are now known to be associated with low weight at birth. The gene expression which establishes metabolic and functional capacity and response to later environment is influenced by the nutrition in early period of fetal life, infancy and early childhood making the first 5 years of life, the crucial years.[14]

It has been seen that mothers with low BMI and inadequate weight gain during pregnancy lead to faltering fetal growth and also increase the risk for preterm deliveries. It has also been seen in recent studies that impaired growth in infancy followed by accelerated increase in childhood weight, worsens the effect of impaired prenatal growth.

There is strong evidence that nutritional status of a woman can alter the epigenetic state of the fetal genome. This molecular mechanism has an impact of maternal nutrition on genomic imprinting and fetal programming, benefits of good nutrition and damaging effects of malnutrition, pass from one generation to the next, by these genome imprinting.[15]

Causes for Low Birth Weight

Low birth weight is categorized by:

- Neonates (born before 37 weeks of gestation)
- Small for gestational age
- Preterm and also small for gestational age neonates, who typically have the worst outcomes.[14,15]

There are multiple causes of LBW:

- Early induction of labor or cesarean birth (for medical or nonmedical reasons)
- Multiple pregnancies
- Infections
- Diabetes
- High blood pressure

Low birth weight is known to have long-term consequences including:

- Fetal and neonatal mortality and morbidity

JAYPEE BROTHERS

for detailed information on nutrition books, visit our website www.jaypeebrothers.com, for detailed information on nutrition books, visit our website www.jaypeebrothe

Apollo
Clinical Nutrition
Handbook

Salient Features

- Food, nutrition and health are intimately connected aspects of our life
- Nutrition is essential for good health and plays an important role in growth and development and in prevention of diseases
- Optimum nutrition is associated with the stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases (NCDs) and longevity
- Includes preventive and curative aspects of dealing with various NCDs such as obesity, diabetes mellitus, cancer, cardiovascular, metabolic, neurological and renal disorders
- The book ventures into women's health, paediatric and geriatric nutrition. Special attention is given on Medical Nutrition Therapy (MNT) for organ transplants
- The book is a comprehensive and evidence-based practical handbook which is useful for all the dieticians and clinicians as an easy reference to offer patients' effective nutrition intervention and counselling
- It is an educational tool for nutritional management of overall health and disease conditions.

Printed in India

Available at all medical bookstores
or buy online at www.jaypeebrothers.com



JAYPEE BROTHERS
Medical Publishers (P) Ltd.
EMCA House, 23/23-B, Ansari Road,
Daryaganj, New Delhi - 110 002, INDIA
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers

Shelving Recommendation
NUTRITION

ISBN 978-93-5465-089-5