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Maternal Nutrition: The Basis for a Healthy Future

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Introduction

Maternal nutrition refers to the nutritional state of women prior to conception, throughout pregnancy, and during breastfeeding. It is crucial for ensuring the health and wellness of both the mother and the developing infant. Sufficient nutrition at this stage not only aids in the physiological adjustments in the mother but also influences fetal development, birth results, and the child's long-term health. Conversely, inadequate maternal nutrition can result in issues such as low birth weight, premature delivery, and health problems for the mother.

Significance of Nutritional Needs During Pregnancy

Adequate nutrition during pregnancy is crucial for the health of both mother and fetus. Increased energy, protein, vitamins, and minerals are needed to support fetal growth and maternal tissue expansion. Key nutrients like iron, folic acid, calcium, iodine, and omega-3 fatty acids are vital in preventing issues such as maternal anemia, neural tube defects, and poor fetal brain development. A balanced diet promotes healthy birth weight, reduces complications like preterm birth, and aids maternal recovery. In contrast, inadequate nutrition can lead to low birth weight and higher infant illness and death rates. Meeting nutritional needs during pregnancy is essential for safe motherhood and long-term health for both mother and child.

Essential Nutritional Needs Throughout Pregnancy

1. **Calories**- During the second and third trimesters, caloric requirements rise by approximately 300–400 kcal daily to facilitate fetal development and the expansion of maternal tissues.

2. **Protein**-Protein is vital for developing fetal tissues, the placenta, and maternal muscles, with a recommended intake of about 1.1 g/kg of body weight each day.

3. **Iron**- Iron is essential for preventing anemia during pregnancy and helps in the transportation of oxygen, with a recommended intake of 27 mg/d; it is important to include iron-rich foods like leafy greens, legumes, meats, and fortified cereals in your diet.

4. **Folic Acid**-Folic acid plays an essential role in reducing the risk of neural tube defects in a developing fetus, and a recommended daily intake of 400–600 µg is advised both prior to and during the early phases of pregnancy.

5. **Calcium and Vitamin D**- Calcium and vitamin D are necessary for the development of fetal bones and the maintenance of maternal bone health, with dairy products, ragi (finger millet), and sunlight being beneficial sources. Recommended intake of calcium is 800 mg/day, and it increases up to 1000 mg/d during the third trimester, and recommended intake of Vitamin D is 600 IU/d.

6. **Iodine**- Iodine is critical for the development of the brain and proper thyroid activity, since a lack of it can result in issues such as cretinism and difficulties with cognition. Recommended intake of iodine is 220µg/d.

7. **Omega-3 fatty acid**- Omega-3 fatty acids support the development of the brain and retina in the fetus, and are found in sources such as flaxseeds, walnuts, and fatty fish.

SUMMARY OF EAR FOR INDIANS -ICMR- NIN, 2020

Age Group	Category of work	Body Wt (kg)	Energy (**) (Kcal/ d)	Protein (g/d)	Cal cium (mg/ d)	Magnes ium (mg /d)	Iron (mg/ d)	Zinc (mg/ d)	Iodine (µg/ day)	Thiamine (mg/ d)	Ribo flavin (mg/ d)	Niacin (mg/d)	Vit B6 (mg/ d)	Folate (µg /d)	Vit B12 (µg/ d)	Vit C (mg/ d)	Vit A (µg/ d)	Vit D (IU/d)
Men	Sedentary	65	2110	43.0	800	370	11	14.1	95	1.2	1.6	12	1.6	250	2	65	460	400
	Moderate		2710							1.5	2.1	15	2.1					
	Heavy		3470							1.9	2.7	19	2.6					
Women	Sedentary	55	1660	36.0	800	310	15	11.0	95	1.1	1.6	9	1.6	180	2	55	390	400
	Moderate		2130							1.4	2.0	12	1.6					
	Heavy		2720							1.8	2.6	15	2.1					
	Pregnant woman	55 + 10	+ 350	+7.6 (2nd trimester) +17.6 (3rd trimester)	800	370	21	12.0	160	1.6	2.3	+2	1.9	480	+0.2	+10	406	400
	Lactation 0-6m	-	+600	+13.6	1000	335	16	11.8	200	1.7	2.5	+4	+0.22	280	+0.8	+40	720	400
	7-12m		+520	+10.6							2.4		+0.16					
Infants	0-6 m*	5.8	530	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6-12m	8.5	680	9.0	-	-	2	2.1	-	-	-	-	0.5	71	1	-	170	-
Children	1-3y	12.9	1110	10.0	400	73	6	2.8	65	0.6	0.8	6	0.8	97	1	24	180	400
	4-6y	18.3	1360	13.0	450	104	8	3.7	65	0.8	1.1	8	1.0	111	2	27	240	
	7-9 y	25.3	1700	19.0	500	144	10	4.9	65	1.0	1.3	10	1.3	142	2	36	290	
Boys	10-12y	34.9	2220	27.0	650	199	12	7.0	70	1.3	1.7	12	1.7	180	2	45	360	400
Girls	10-12y	36.4	2060	27.0	650	207	16	7.1	70	1.2	1.6	12	1.6	186	2	44	370	400
Boys	13-15y	50.5	2860	36.0	800	287	15	11.9	100	1.6	2.2	16	2.2	238	2	60	430	400
Girls	13-15y	49.6	2400	35.0	800	282	17	10.7	100	1.3	1.9	13	1.8	204	2	55	420	400
Boys	16-18y	64.4	3320	45.0	850	367	18	14.7	100	1.9	2.5	19	2.5	286	2	70	480	400
Girls	16-18y	55.7	2500	37.0	850	317	18	11.8	100	1.4	1.9	14	1.9	223	2	57	400	400

Physiological Changes During Pregnancy

Hormonal signals from the placenta initiate physiological changes that enhance maternal and fetal oxygen delivery and nutrient transport. These changes may influence the results of biochemical tests and unmask preexisting conditions. Knowledge of these changes by trimester is crucial for the appropriate interpretation of laboratory data as well as the detection of abnormalities. This article summarizes significant alterations in various physiological systems during pregnancy.

1. Respiratory System- Pregnancy hormones impact the respiratory system, causing nasal congestion, voice changes, and a higher risk of upper respiratory infections. The expanding uterus raises the diaphragm about 4 cm, slightly reducing lung capacity, but chest dimensions increase by 5 to 7 cm, compensating for this. As pregnancy advances, expiratory reserve volume and residual volume decrease, possibly down to 20% of pre-pregnancy levels by delivery.

Progesterone relaxes muscles, lowering airway resistance, while lung compliance stays stable. By the second trimester, tidal volume increases by 40% and respiratory rate by 15%, resulting in a 50% boost in minute ventilation. This hyperventilation can lead to respiratory alkalosis, particularly during labor, which may affect oxygen delivery to the fetus. By the end of pregnancy, oxygen consumption increases by about 20% and can exceed 60% during labor.

Cardiovascular System- During pregnancy, the heart enlarges due to chamber hypertrophy and dilation, causing the apical impulse to shift upward and laterally, along with mild tricuspid regurgitation. Systemic vascular resistance decreases, while pulmonary artery pressure stays normal. Progesterone and nitric oxide help relax smooth muscle and lower vascular reactivity, increasing the risk of hypotension.

Femoral venous pressure rises due to mechanical influences, reducing afterload and increasing preload. Cardiac output (CO) increases by 30–40% in the first trimester, mainly from a 35% rise in stroke volume and a 15% increase in heart rate. CO peaks in the knee-chest or left lateral positions and is lowest when standing or lying supine.

During labor, CO rises further due to catecholamine release and an additional 300–500 mL of blood from the contracting uterus. After childbirth, autotransfusion can enhance CO by 50%, posing risks for individuals with existing heart conditions.

Gastrointestinal System - Increasing levels of human chorionic gonadotropin (hCG) enhance estrogen production, leading to nausea and vomiting in up to 70% of individuals during the first trimester. This usually resolves with supportive care by the end of the first trimester for about 60% of patients and 90% by 20 weeks. Severe cases, known as hyperemesis gravidarum, may require hospitalization.

Progesterone relaxes the lower esophageal sphincter and affects stomach positioning due to the expanding uterus, causing reflux and heartburn in up to 80% of patients near term. While gastric emptying time remains normal, it takes longer, increasing the risk of constipation. Aspiration risk rises during labor but returns to pre-pregnancy levels within 24 to 48 hours post-delivery.

Reduced gallbladder motility can lead to biliary sludge and gallstones, with higher residual volumes during pregnancy that normalize after childbirth. Biliary colic is common and often improves with conservative treatment; if surgery is needed, the second trimester is the best time for it, as it is generally well tolerated.

The liver's blood supply does not significantly increase during pregnancy, but its activity and synthetic function enhance, leading to variations in liver enzyme levels.

Renal System - During pregnancy, increased cardiac output boosts renal plasma flow and glomerular filtration rate (GFR) by up to 50% by term, causing a 40–50% drop in blood urea nitrogen (BUN) and creatinine levels. This higher GFR may lead to mild glycosuria (up to 300 mg/day) and aminoaciduria due to the renal tubules' limited reabsorption.

In the postpartum period, physiological diuresis occurs from the second to fifth days, with GFR and BUN returning to nonpregnant levels by the sixth week. After week 12, progesterone dilates the renal calyces and ureters, increasing the risk of urinary stasis and infections from the growing uterus.

Endocrine System- Hormonal changes during pregnancy affect the body's internal environment and hormone levels. Beta-human chorionic gonadotropin (β-HCG) can activate thyroid-stimulating hormone (TSH) receptors, potentially causing temporary hyperthyroidism, although free T3 and T4 levels usually remain normal.

Fasting blood sugar levels are typically lower in pregnant women, but declining glucose tolerance due to placental lactogen can lead to gestational diabetes. This condition often resolves after delivery, but babies of diabetic mothers may face risks like macrosomia and hypoglycemia, which can cause seizures. Additionally, increased cortisol levels create insulin resistance and enhance skin pigmentation during pregnancy.

Musculoskeletal Changes- Relaxin and estrogen play a role in enhancing ligament looseness, especially in the pelvic region. Although this increased laxity facilitates better adaptation for the developing fetus, it may also result in musculoskeletal discomfort and increase the likelihood of subluxation or dislocation.

Dermatological System -Darkening of certain parts of the body, including the face, neck, and the central area of the abdomen, often happens during pregnancy. This alteration is caused by melanocyte-stimulating hormone. Furthermore, stretch marks, known as striae gravidarum, appear as pregnancy advances.

Ocular Changes - Elevated amounts of progesterone and relaxin, along with a decrease in the production of aqueous humor, result in diminished intraocular pressure. This reduction can cause visual irregularities and difficulties tolerating contact lenses.

Obstacles Impacting Maternal Nutrition

Maternal nutrition is shaped by social, economic, cultural, and biological factors. Economic issues like poverty and food insecurity restrict women's access to varied, nutrient-rich diets (Black et al., 2013). Cultural norms may limit intake of essential foods during pregnancy, leading to nutrient deficiencies (UNICEF, 2022). Nutrition illiteracy further exacerbates these issues, resulting in deficiencies in key nutrients like iron and folic acid (ICMR-NIN, 2020). Adolescent pregnancies pose additional risks as young mothers often face their own nutritional challenges (WHO, 2021). Lack of antenatal care and poor delivery of nutrition interventions prevent mothers from receiving necessary support (MoHFW, 2018). Together, these factors perpetuate a cycle of malnutrition and poor health for mothers and their babies.

Strategies to Improve Maternal Nutrition

Enhancing maternal nutrition requires a comprehensive approach that includes education, supplementation, community involvement, and policy measures. Nutrition education during antenatal care raises awareness about healthy diets and essential micronutrients (WHO, 2021). Supplementation with iron, folic acid, and calcium is vital to prevent anemia and support fetal growth (ICMR-NIN, 2020). Food fortification, such as adding essential nutrients to staple foods, effectively addresses micronutrient deficiencies (UNICEF, 2022). Improving healthcare delivery with regular antenatal visits and community

health worker engagement enhances access to nutritional support (Bhutta et al., 2013). Government initiatives like POSHAN Abhiyaan and ICDS in India also aim to integrate health and nutrition efforts (MoHFW, 2018). Addressing these interconnected areas can significantly reduce maternal malnutrition and improve health outcomes for mothers and children.

Maternal Nutrition from an Ayurvedic Perspective

From an Ayurvedic perspective, maternal nutrition (Garbhini Poshan) is crucial for ensuring a healthy and intelligent child. Pregnancy is seen as a transformative phase that requires Sattvic Ahara (pure, nourishing food), a balanced lifestyle, and mental calmness to support both the mother and fetus. Classical texts like the Charaka Samhita and Sushruta Samhita emphasize that adequate nutrition not only nurtures the mother but also significantly influences the physical, mental, and spiritual development of the fetus.

Ayurveda emphasizes Rasa Dhatu, the essence of nutrition, as vital for building and nourishing body tissues, including those crucial for fetal development (Lad, 2002). The diet and lifestyle of the expectant mother are believed to directly affect the fetus's Dhatus. It is recommended that mothers consume fresh, warm, light, and easily digestible foods rich in natural Prana (life energy). Additionally, maintaining Vata Dosha balance is important during pregnancy to prevent complications like preterm labor and anxiety (Sharma, 2017).

Month-wise Ayurvedic Dietary Guidelines

Ayurveda offers detailed, month-wise dietary recommendations during pregnancy (*Masanumasika Pathya*), as described in the *Charaka Samhita*:

- **1st–3rd month**: Light, liquid, and cooling foods such as milk, rice gruel (*Paya*), and ghee are suggested to support implantation and early fetal organ formation.
- **4th–6th month:** Sweet, nourishing, and slightly oily foods, including milk, ghee, butter, and rice pudding, enhance fetal tissue growth and maternal strength.
- **7th–8th month**: Easily digestible foods, soups made of green gram (*Mudga Yusha*), and mild herbal decoctions help sustain maternal stamina and digestive balance.
- **9th month**: Medicated ghee consumption and oil massages (*Abhyanga*) are advised to lubricate tissues, strengthen muscles, and prepare the body for smooth labor and delivery (Charaka Samhita, *Sharira Sthana* 8).

Essential Ayurvedic Nutrients and Herbs

Ayurveda identifies several *Rasayana dravyas* (rejuvenating substances) and foods that support maternal and fetal health:

- **Shatavari (*Asparagus racemosus*):** Promotes reproductive health, improves lactation, and strengthens uterine muscles (Bhavaprakasha Nighantu, 2019).
- **Amalaki (*Emblica officinalis*):** Rich in vitamin C and antioxidants; enhances immunity and tissue repair (Sharma, 2017).
- **Ghee and milk**: Provide *Ojas* (vital energy), fostering physical vitality and emotional stability (Tiwari, 2018).

- **Moringa (*Shigru*):** Naturally boosts iron, calcium, and protein levels, supporting both maternal and fetal nourishment.
- **Dates and almonds:** Strengthen the body, enhance blood formation, and maintain maternal stamina (Lad, 2002).

Shatavari (*Asparagus racemosus*)

Amalaki (*Emblica officinalis*)

Moringa (*Shigru*)

Dates and almonds

Lifestyle and Mental Well-being

Ayurveda emphasizes the importance of mental and emotional health during pregnancy for the fetus's development. Positive thinking, a calm atmosphere, and spiritual practices are vital. Activities like Garbhini Yoga, meditation, and nurturing relationships help maintain dosha balance and promote tranquility. Conversely, negative emotions like stress and anger can disrupt Vata and Pitta doshas, affecting fetal development and pregnancy outcomes.

Conclusion

Maternal nutrition is essential for the health and well-being of both mother and child. Adequate nutrition before conception, during pregnancy, and lactation supports maternal physiological changes and optimal fetal development, helping to prevent issues like anemia and low birth weight. Key nutrients such as iron,

folic acid, calcium, iodine, and omega-3 fatty acids are vital for health, while education and government initiatives enhance public health outcomes.

The Ayurvedic perspective complements this by emphasizing overall well-being, combining physical nourishment (Ahara), mental tranquility (Manas), and spiritual harmony (Sattva). Practices like Garbhini Poshan and Masanumasika Pathya, along with herbs like Shatavari and Moringa, promote vitality and immune strength.

Together, modern nutrition and Ayurveda highlight that maternal nutrition is more than dietary sufficiency; it nurtures the mother as the life-giver, establishing a foundation for healthier mothers, stronger infants, and a better future for society.

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