م.م.إيمان هادي عودة
م.م.مريم جواد عبد اللطيف

Life Cycle Nutrition
Pregnancy and Lactation

Nutrition during pregnancy

The tremendous growth of a baby from the moment of conception to the time of birth depends entirely on nourishment from the mother. The complex process of rapid human growth and lactation demands a significant increase in nutrients from the mother's diet. Good nutrition during the 38 to 40 weeks of a normal pregnancy is essential for both mother and child. In addition to her normal nutritional requirements, the pregnant woman must provide nutrients and calories for the fetus, the amniotic fluid, the placenta, and the increased blood volume and breast, uterine, and fat tissue. An expectant mother's nutritional status can affect the outcome of pregnancy. For example, during the first month of gestation, the mother must be well nourished so that the placenta that forms will be healthy. Because the entire embryo and fetus's major body organs form within 2 to 3 months of conception, nutrition during this time is critical to the health of the child. Required nutrients come from the mother's diet or body stores.

Energy needs

Increased energy is needed to sustain the mother and for the development of the fetus and the placenta. From the fourth through the sixth month, the second trimester, much of this energy supports the growth of the uterus (womb) and other maternal tissues. During the seventh through ninth months, the third trimester, much of the energy supports the fetus and the

placenta. To meet this increased metabolic workload and to spare protein for tissue building, a pregnant woman needs an extra:

■ 340 kilocalories per day in the second trimester
■ 452 kilocalories per day in the third trimester

On average the pregnant woman will need to increase daily caloric intake by approximately 300 kilocalories per day. The increase in calories should be from high nutrient density foods.

Fat needs

Long-chain polyunsaturated fatty acids (LC-PUFAs) have demonstrated crucial importance in the development of the fetal retina and brain. LC-PUFAs, docosahexaenoic acid (DHA), and arachidonic acid (AA) accumulate in the fetal brain rapidly during the third trimester of gestation and during the early postnatal period. These essential fatty acids can be supplied directly from the diet or synthesized from the omega-6 fatty acids and omega-3 fatty acid families. Because of the importance of DHA to fetal brain development, it is recommended that pregnant women consume 300 mg each day. The adequate intakes (AIs) for omega-6 fatty acids (linoleic acid) and omega-3 fatty acids (alpha-linolenic acid) are increased during pregnancy and lactation compared to amounts designated for other women. Food sources of linoleic acid are the following oils:

■ Corn ■ Safflower ■ Sunflower

Alpha-linolenic acid is found in these oils:

■ Canola ■ Flaxseed ■ Soybean ■ Walnut

Important sources of DHA are fish and shellfish, because conversion by the body is not required. Consequently, a pregnant woman’s diet should contain oils as well as seafood.

Protein needs

Protein is required to build fetal tissue. The mother also needs adequate protein for growth of her tissues. Her blood volume increases in anticipation of blood loss at delivery. Her breasts develop in preparation for lactation. Her uterus enlarges and contains a sac filled with amniotic fluid. For those reasons, the recommended dietary allowance (RDA) for protein for pregnant women is 54% more than for nonpregnant women. Translating this need to the exchange system, 2 extra cups of milk (16 grams of protein) and 1.5 additional ounces of meat (10.5 grams of protein) each day would more than meet the increased protein requirement. Protein intake becomes a hazard to the fetus when the mother has phenylketonuria and is eating inappropriately. The goal of treatment with phenylketonuria is to maintain phenylalanine levels within safe limits. The limit in pregnant women is 120 to 240 umol/L to ensure normal growth and prevent mental retardation in the fetus. All women should be asked directly if they have ever had a special diet prescription. The healthcare provider should investigate further when a woman cites a history of troubled pregnancies, congenital abnormalities, a mentally retarded infant, spontaneous abortion, or stillbirth.

Vitamin needs

Pregnant women have an increased need for some vitamins. They must avoid taking excessive amounts of others because of potential hazard to the fetus.

Water-Soluble Vitamins

A pregnant woman's RDA for vitamin C is 13% higher than that of a nonpregnant woman. Vitamin C is necessary for collagen formation and tissue building. The RDAs for all the B vitamins except biotin are modestly

increased for pregnancy. The increased requirements are understandable-particularly for thiamin, niacin, and vitamin B_6, which are coenzymes involved in energy metabolism. Two other B vitamins are of special concern in pregnancy: vitamin B_{12} and folic acid.

Vitamin B_{12}

The vitamin B_{12} RDA is only slightly increased for pregnant and lactating women. The placenta appears to concentrate vitamin B_{12} because serum levels in the newborn are about twice the maternal levels. Vitamin B_{12} is concentrated and stored in the fetal liver during pregnancy and provides the infant with stores to sustain them for the first several months of life. Strict vegetarians are at high risk of nutritional vitamin B_{12} deficiencies, which can have a greater effect on the infant than on the mother. Vegetarians need to ensure adequate intake of vitamin B_{12} from fortified foods or supplements. Fortified food and supplements made from cobalamin provide a physiologically active form of the vitamin, whereas products that list only vitamin B_{12} might include nonbioavailable sources. Vitamin B_{12} deficiencies have shown to result in neurological insult to the infant.

Folic acid

The RDA for folic acid for all women of childbearing potential specifies synthetic folic acid from fortified foods or supplements. In addition, food folate from a varied diet is expected to be consumed. These recommendations are based on clinical studies that showed that 4 mg of folic acid daily prevented 72% of neural tube defects (NTDs) in infants of women who have already delivered a child afflicted with the defect. The Centers for Disease Control and Prevention (CDC) quickly recommended the treatment for such high-risk women beginning folic acid 1 month before conception

and continuing until3 months of pregnancy. Studies have demonstrated that periconceptional consumption of adequate folic acid, of 4 mg daily, can prevent 50% to 70% of NTDs. Despite recommendations for women of childbearing age to increase folic acid intake, most women have not done so. Consequently, folic acid has been added to the enrichment protocol for cereal-grain products in the United States since January 1998; 140 mcg of folic acid has been incorporated into each 100 grams of grain. Following the initiation of folate fortification, the prevalence of spina bifida decreased 31% and of anencephaly 16%. Data demonstrate that Hispanic women continue to be at a significantly greater risk for having a baby affected with NTD than non-Hispanic white women and black women, who also have a lowest risk. Although there is strong data that conclusively confirms a decreased incidence in NTD when women consume adequate folic acid before and during pregnancy, data suggests that less than 50% of women of childbearing age are actually taking folic acid daily. A woman's knowledge of folic acid and its role in preventing NTDs is essential for reducing the risk of NTD. Health-care providers need to increase their efforts to promote adequate folic acid intake among fertile women. Specific target populations include the following:

- Young women
- Hispanic and black women
- Women with low incomes
- Women with less than a high school education

Fat soluble vitamins

The RDA for vitamin E and the AI for vitamin K are the same for pregnant women as for mature, nonpregnant women. Interfering with normal physiology can create problems, however. During normal pregnancy, the placenta transfers limited amounts of vitamin K to the fetus. Significant bleeding problems are rare, but infants are treated with vitamin K at birth. Vitamins D and A merit special mention even for normal pregnancies.

Vitamin D

Vitamin D has multiple functions in the growth and development of the fetus, including immune system development, brain development, and cellular differentiation. Attention is being brought to the effects of maternal vitamin D deficiency in relationship to the development and outcomes of the infant. If a woman is vitamin D deficient, it appears to have a greater impact on fetal than maternal bone health. Severe vitamin D deficiency during gestation and early life is a primary cause of rickets in infants and children and can be accompanied by hypocalcemic seizures. Further research is being done to investigate the current vitamin D recommendations for pregnant women.

Vitamin A

Vitamin A excess in pregnant women has been related to birth defects. Vitamin A as retinol or retinoic acid in excess of 10,000 IU per day or treatment with isotretinoin during the first trimester increases the risk of retinoic acid syndrome. The characteristic fetal deformities include the following:

- Small or no ears
- Abnormal or missing ear canals
- Brain malformation
- Heart defects

Three ounces of beef liver may contain 27,000 IU, and 3 oz of chicken liver, 12,000 IU. A pregnant woman who eats liver regularly may consume enough

vitamin A to pose a risk to her baby. A well-balanced diet should supply the RDA for pregnant women, and a supplement is generally not recommended. Some prenatal vitamins substitute beta-carotene, which is not associated with birth defects, for preformed vitamin A or omit vitamin A entirely. Isotretinoin, a vitamin A metabolite used to treat severe acne, is hazardous to the fetus with almost a 30% risk of malformations if a woman is exposed to isotretinoin during the first trimester. Despite a pregnancy prevention program started by the manufacturer of isotretinoin in 1988 and subsequent upgrades, women are still becoming pregnant while taking the drug. Requiring client registration and negative pregnancy tests before each prescription is dispensed have not eliminated the danger to fetuses. Women of childbearing age taking isotretinoin should adhere to strict contraceptive protocols, including simultaneous use of two reliable methods. A woman who ceased taking isotretinoin 3 months before becoming pregnant still manifested teratogenic effects: conjoined twins. In contrast, vitamin A deficiency (VAD) is a greater problem than toxicity in developing countries. VAD is a public health problem in Africa with preschool-age children and women of reproductive age being at the greatest risk. VAD has been associated with night blindness, severe anemia, increased maternal mortality for 1 to 2 years following delivery, and premature and/or LBW deliveries.

Mineral needs

The trace mineral iron plays a major role in the health of the mother and fetus and therefore appears first in the discussion. Other minerals of special concern in pregnancy are calcium, iodine, fluoride, and zinc.

Iron

During pregnancy, the mother's plasma volume increases by about 45% to 50% by the 34th week of gestation, and her red cell mass increases by about 33%. Besides supporting the mother's increased blood volume, iron supports the red blood cells in the fetus, placenta, and umbilical cord. As a result, the net iron cost of a singleton (one fetus) pregnancy is estimated

at 1 gram. Even moderate iron deficiency anemia (IDA) is associated with twice the risk of maternal death. The fetus receives all iron stores from the mother, with 600 mg coming from maternal dietary intake and 400 mg coming from maternal stores. IDA in the first trimester is associated with greater than a twofold increase in the risk of LBW or preterm delivery. Long-term IDA during pregnancy may cause permanent damage to the brain, which negatively affects intelligence, cognitive abilities, and behavior later in life. Fortunately, the body adjusts to limited or abundant iron sources, and iron absorption is enhanced in the second and third trimesters of pregnancy. Rates of iron absorption vary so that women who begin pregnancy:

- with adequate iron stores, absorb about 10% of ingested iron;
- with low iron stores, absorb about 20%; and
- anemic, absorb about 40%.

The RDA for iron for pregnancy assumes an absorption rate of 20%. The average maternal need for extra iron averages close to 800 mg, elemental iron daily; 300 mg is required for the fetus and the placenta, which will be delivered at the expense of the mother. Prophylactic iron at 60 mg per day is recommended by the World Health Organization for all pregnant women for 6 months. Even when she takes supplements, a woman's hemoglobin and hematocrit should be monitored regularly. Lower values are expected during the first and second trimesters because expanding blood volume dilutes the concentration of red blood cells. Prescribed iron supplements may not be taken. Economic factors or side effects, such as nausea, cramps, gas, and constipation, may influence intake. Although oral iron preparations are best absorbed if taken 1 hour before or 2 hours after meals, individualizing the schedule is better than the client choosing to

eliminate the supplement altogether. Iron supplements should be taken as directed.

Calcium

Throughout pregnancy, approximately 30 grams of calcium are transferred to the fetus, most of it in the third trimester. Fetal calcium deposition typically peaks to 350 milligrams per day in the third trimester and maternal absorption increases to meet that demand. More calcium is absorbed by the intestine during pregnancy because of increased maternal vitamin D to meet the fetus's needs. Maternal bone loss that occurs to support the demands of pregnancy and lactation are recovered by 1 year postpartum. Transient osteoporosis is a rare, self-limiting syndrome typically characterized by hip pain in the third trimester of pregnancy accompanied by radiologic osteopenia; other joints may be affected as well. Etiology is unclear, with the left hip more often involved than the right and bilateral hips affected in 25% to 30% of pregnant women. Usual treatment is supportive during the mean duration of 6 to 8 months. The condition usually resolves in 3 to 6 months.

Iodine, Fluoride, and Zinc

As part of thyroid hormones, iodine is essential to the control of metabolism. During the second half of pregnancy, resting energy expenditure increases by as much as 23%. The RDAs for iodine are increased by 46% and 93% for pregnant and lactating women over those of other women. In the United States, a pregnant woman's usual need for iodine is met by the use of iodized salt. Severe maternal deficiency can cause cretinism in the newborn. The fetus begins to develop teeth at the 10th to 12^{th} week of pregnancy. Fluoride crosses the placenta so that the concentration in fetal circulation is one-fourth that of the mother; fluoride is

found in fetal bones and teeth. The American Academy of Pediatric Dentistry (2012) does not support the use of prenatal fluoride supplements. The AI for pregnancy and lactation is the same as for nonpregnant women. Zinc is not mobilized from the mother's tissues. To provide for the fetus, the mother needs regular intake. Well-balanced diets provide the RDA for women who are pregnant and lactating, and supplementation is not recommended. The RDAs for pregnant and lactating women are about 50% higher than those for other women. Lean meat from beef chuck roast, 3.5 to 4 ounces, would provide these RDAs.

Substances to avoid

While pregnant or nursing, women are urged to limit caffeine intake and to eliminate these items from their diets:

- Alcohol
- Soft cheeses and ready-to-eat meats
- Certain species and amounts of fish
- Undercooked meat and unwashed produce

Problems and complications of pregnancy affecting nutrition

The most common problems of pregnancy are:

1. Morning sickness
2. Leg cramps
3. Constipation
4. Heartburn
5. **Pica** is the compulsive ingestion of nonfood items, usually dirt, clay, laundry starch, baking soda, or ice. It is an ancient behavior and a regional practice that is mainly influenced by culture.

Lactation

A woman needs to decide whether to breastfeed before her infant is born. Almost all women can breastfeed; breast size is no barrier. Lactation, the production and secretion of breast milk for the purpose of nourishing an infant, is facilitated by an interplay of various hormones after delivery of the infant. Oxytocin and prolactin instigate the lactation process. Prolactin is responsible for milk production, and oxytocin is involved in milk ejection from the breast. The infant's sucking initiates the release of oxytocin, which causes the ejection of milk into the infant's mouth.

Table (1): Benefits of Breastfeeding Compared with Using Breast Milk Substitutes (i.e., Formula)

BENEFITS FOR INFANTS	BENEFITS FOR MOTHERS
• Optimal nutrition for infant • Strong bonding with mother • Safe, fresh milk • Enhanced immune system • Reduced risk for acute otitis media, nonspecific gastroenteritis, severe lower respiratory tract infections, and asthma • Protection against allergies and intolerances • Promotion of the correct development of the jaw and teeth • Association with higher intelligence quotient and school performance through adolescence as a function of parental skill • Reduced risk for sudden infant death syndrome • Reduced risk for chronic diseases such as obesity, type 1 and 2 diabetes, heart disease, and childhood leukemia • Reduced risk for infant morbidity and mortality	• Strong bonding with infant • Increased energy expenditure, which may lead to faster return to prepregnancy weight • Faster shrinking of the uterus • Reduced postpartum bleeding • Delayed return of the menstrual cycle • Decreased risk for chronic diseases such as type 2 diabetes and breast and ovarian cancer • Improved bone density and decreased risk for hip fracture • Decreased risk for postpartum depression; enhanced self-esteem in the maternal role • Time saved by not having to purchase, prepare, and mix formula • Money saved by not buying formula and from not having to pay the increased medical expenses associated with formula feeding

References

- Schiff, W., J. The Nutrition for Healthy Living. 2nd ed., 2011. The McGraw-Hill Companies, Inc.