Maternal Nutritional Deficiencies and Interventions

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Nutrition plays an important role in maternal and child health. Poor maternal nutrition status has been associated with poor maternal and fetal outcomes. Apart from poor maternal nutrition, biological, socioeconomic, teenage pregnancy, short interpregnancy interval and demographic factors in different populations also influence poor birth outcomes [1]. Multiple nutrient deficiencies are generally observed in low socioeconomic status [2]; however, a review of the literature indicates that a majority of studies are based on single nutrient deficiency with birth outcomes; therefore, it is necessary to study in depth, the multiple nutrient deficiencies and birth outcomes. Poor maternal outcomes include increased risk of maternal mortality, anemia, pregnancy-induced hypertension (PIH), third trimester bleeding, premature rupture of membranes, prolonged labor, postpartum hemorrhage, and puerperal endometritis. The adverse major fetal birth outcomes are low birth weight (LBW), preterm birth, and intrauterine growth retardation (IUGR) which are leading causes of neonatal deaths in the absence of congenital malformations [3]. They are also associated with short- and long-term health problems (e.g., neurologic disorders, learning disability, childhood psychiatric disorders, mental retardation, etc.) and chronic diseases in adult life [4]. LBW can occur

because of preterm delivery or IUGR or both and causes 40–80 % neonatal deaths especially in developing countries [3]. The cost of hospitalization and treatment of LBW and preterm infants are extremely high immediately after birth as well as 4–10 times higher in first 10 years of life. Matthew et al. [5] and many researchers have reported that maternal nutrition did not play much role on birth weight in industrialized countries. This may be due to the mean daily intake from food of energy and fiber, and seven out of ten micronutrients were at or above the dietary reference values which were recorded as early as 9–20 weeks of gestation. In the United States, Programs for Nutritional Intervention in preconceptional and during first trimester with low socioeconomic status have shown lower incidence of LBW [6].

In developing countries, improvement in maternal nutrition is associated with increased fetal growth and decrease in adverse maternal and birth outcomes. Shah et al. [7] reported significant reduction in LBW babies among women receiving multi-micronutrient supplements compared with women only receiving iron and folic acid supplements, and therefore, advocated change in public health policies all over the world for multi-micronutrient supplementation for pregnant women.

Maternal nutritional deficiencies result from inadequate dietary intake of energy, proteins, essential fatty acids (especially omega 3 fatty acids), iron, folate, and other micronutrients during pregnancy, i.e., during rapid growth phases. Energy is the main nutritional determinant of pregnancy weight gain; however, it also depends on the

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increase in basal metabolism during pregnancy, physical activity, the composition of accumulated maternal fetal tissue, and deficiency of specific nutrients. Food and Agriculture Organization/World Health Organization (WHO)/United Nations University [8] recommend pregnant women to have their energy intake increased by 85, 285, and 475 kcal/day during the first, the second, and the third trimesters of pregnancy, respectively. In rural India, higher maternal food intake along with restricted physical activity during the later part of pregnancy was associated with increased birth weight [9]. For women of low socioeconomic status, diets are based predominantly on cereals and are the main sources of protein. During pregnancy, large amount of lysine and other amino acids obtained from cereals play an important role in the synthesis of proteins. It has been observed that chronically undernourished Indian women who eat dairy products at least every other day in early pregnancy without protein intake from animal sources had infants with significantly higher birth weights [9]. Essential fatty acids such as omega 6 and omega 3 fatty acids and polyunsaturated fatty acids are essential for fetal development. Being important structural elements of cell membrane, they are essential for the formation of new tissues. They cannot be synthesized in our body, and hence, diet remains the main source. It has been reported that during pregnancy, the high intake of marine food containing high amount of long chain omega 3 fatty acids was associated with improved fetal growth and increased duration of gestation. However, trials of omega 3 fatty acid supplementation showed mixed outcomes.

WHO in their review of nationally representative survey from 1993 to 2005 reported that 42 % of pregnant women were anemic globally, and 90 % of these women belonged to Africa and Asia [10]. In India, the prevalence of anemia is the highest in the world. Indian diets usually suffer from lack of iron, folic acid, and vitamin B12 because of low vegetable consumption and poor bioavailability from fiber phytate-rich food [11]. Apart from dietary deficiency, malaria, hookworm, and other helminthic infestations also require treatment to reduce anemia. Forty percent of maternal mortality incidences in India are directly or indirectly related to anemia. Maternal mortality rate (MMR) increases 8–10 times when hemoglobin is less than 5 g %. IUGR, prematurity, and LBW cause poor growth during infancy, childhood, and adolescence resulting into low adult height and malnutrition [12]. Many randomized intervention studies with iron supplementation starting in early pregnancy have reported good maternal and birth outcomes. In spite of public health policies providing the iron supplementation to pregnant women throughout the world, iron-deficiency-induced anemia still has remained a challenge to the public health services. WHO recommends universal iron supplementation of 60 mg elemental iron with 250 µg

folic acid for 6 months to all pregnant women, and the Government of India recommends 100 mg of elemental iron with 500 µg of folic acid in the second-half of pregnancy for at least 100 days. The prevalence of maternal anemia can be reduced up to 50 % over a decade if proper action is taken to launch large-scale programs which should be based on successful programs such as those achieved in countries like Thailand and Nicaragua.

Folate is an essential nutrient required for the fetal development as it is a cofactor for many essential cellular reactions including DNA and RNA syntheses. A protective effect of folate against the development of neural tube defects (NTDs) has been well established by multiple clinical research studies in the past. The recommended intake of folic acid is 4 mg/day for those with high risk and 0.4 mg/day for others starting from preconceptional period. However, with this recommendation, the required effect was not achieved, and hence, folic acid fortification was mandated in the United States and some other countries which resulted in the reduction in the frequency of NTDs by 25–30 % [13], while other countries reported reduction from 71 to 91 %. Folic acid intervention also prevents megaloblastic anemia, reduces level of homocysteine, and hence, thrombosis resulting in the reduction in LBW babies, IUGR, and preterm labor.

Calcium is the most abundant mineral in the body, constituting 1.5–2 % of adult body weight of which 99 % is stored in bones. Calcium and phosphorus are involved in mineralization of bones and teeth, energy, cell production, and electrolyte's acid–base buffering. Low level of calcium can cause demineralization of mother's bones and teeth. Several studies have reported that calcium supplementation during pregnancy may reduce risk of PIH, while some others have reported that it does not reduce the incidence but reduces the severity, maternal morbidity, and neonatal mortality. Other micronutrients like iodine, zinc, magnesium, vitamin A, vitamin B6, vitamin B12, and vitamin C also play their respective important roles in improving the birth outcome.

There is sufficient evidence of maternal nutritional interventions in improving maternal health and birth outcomes, and these interventions are maternal supplementation of balanced energy and proteins, iron, folate, calcium, other micronutrients, iodination of salt, maternal deworming in pregnancy, and intermittent preventive treatment for malaria. Similarly, effective interventions in newborn babies are promotion of breast feeding and vitamin A supplementation. In infants and children, the efficacious interventions for improved outcomes include promotion of breast feeding; behavioral change counseling for improved complementary feeding; iron fortification and supplementation programs; zinc supplementation and deworming; vitamin A fortification or supplementation; universal salt

iodination; treatment of severe acute malnutrition; hand washing or maintenance of hygiene; and insecticide-treated bed nets.

India contributes about 20 % of births worldwide and has the highest proportion of children younger than 5 years. The objectives of the National Rural Health Mission are to achieve reduction in the infant mortality rate (IMR) to 30/1,000 live births and reduction in the MMR to 100/100,000 live births. Global progress toward MDG 4 and 5 depends significantly on the improvement in the maternal and child health indicators in India, and maternal nutrition is one of the indicators for improving the maternal and child health care.

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