

Possible severe maternal nutrient deficiencies involved with fetal compromise including increased risk of intrauterine fetal demise (IUFD).

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Adequate maternal nutrition optimizes pregnancy outcomes. Maternal deficiencies during critical phrases of fetal development are associated with adversity. Relationships between of maternal deficiencies and fetal consequences are presented here.

| Maternal Energy Deprivation |
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| ↓ protein → ↓ amino acids, poor muscle maintenance, including heart and major organs (Kim H et al. 2015) |
| ↓ energy → death due to loss of critical lean body mass (heart, brain, lungs, kidneys, enzyme systems, immune factors) (Sinha N et al. 2014) (Wigglesworth JS. 1996) (Kelly R et al. 2017) (Metzer BE et al. 1982) (Falzi G et al. 1990) (MacGibbon KW et al. 2015) (Meguid M. 2015) |
| ↓ carbohydrates with thiamine (vitamin B 1) → Wernicke's Encephalopathy, also wet (cardiac) and dry (neurological) infantile beriberi (Choissi G et al. 2006) (Espay AJ, 2014) |
| ↓ energy → ketone development → acidemia / reduced oxygen delivery → ↓ IQ in offspring (Rao R et al. 2012) |
| ↓ energy (via placental insufficiency or maternal food deprivation) → IUGR and/or SGA → ↑ neonatal morbidity (Kelly R et al. 2017) |
| Maternal Vitamin and Mineral Deprivation |
| ↓ vitamin A → ↓ fetal retinal, renal and pulmonary development (Schwartz E et al. 2017) (Timoneda J et al. 2018) |
| ↓ vitamin D → ↓ fetal skeletal metabolism, lung fibrosis, dilated cardiomyopathy, also ↓ fetal thymus development (Glackin S et al. 2017) (Elidrissy AT, 2016) (Gur ED et al. 2016) (Shi Y et al. 2017) (Omotobara-Yabe T et al. 2018) |
| ↓ vitamin K → ↓ fetal skeletal maturation, fetal subdural hematoma, intraventricular hemorrhage (Toriello HV et al. 2013) (Sasaki Y et al. 2017) |
| ↓ phosphorus, potassium, magnesium → ↓ fetal cardiac and respiratory muscle contractility (Ariyoshi N et al. 2017) (Khandelwal K et al. 2016) |
| ↓ thiamine → ↑ Wernicke's encephalopathy in the mother → ↑ maternal death (Choissi G et al. 2006). IUFD (Majumdar S et al. 2010) (Mayer KH et al. 2019) |
| ↓ vitamin B 12 → ↑ neurological failure in fetus, documented FTT (failure to thrive) in neonates (Akcaboy M et al. 2015) (Halicioglu O et al. 2011) |
| ↓ iron ↓ oxygen-carrying capacity to fetus; and ↓ fetal nerve myelination (60 Georgieff MK, 2008) (Bastian TW et al. 2016) |
| ↓ vitamin C → ↓ fetal collagen development, including vascular integrity, neurological development, placental growth (Schjoldager JG et al. 2015) (Ahn YM et al. 2017) (Sotiriou S et al. 2002) (Bohles H. 1997) (Hill KE et al. 2006) |
| ↓ choline → ↓ acetylcholine, an important neurotransmitter for mother and fetus (Zeisel SH. 2006) |
| ↓ selenium → ↑ myocardial necrosis (Oropeza-Moe M et al. 2015) |
| ↓ phosphorus → ↓ maternal/ fetal brain ATP (Pesta DH et al. 2016) |
| ↓ DHA and arachidonic acid (which account for 30-50% total phospholipids in the retina and gray matter in the fetal brain) ↓ neurogenesis and migration, → hypomyelination in the brain → ↓ visual acuity and attention span. (Piwko J et al. 2013) (Helland IB et al. 2003) |
| Maternal Hydration Deficiency (resulting in oligohydramnios, reduced amniotic fluid volume) |
| ↑ dehydration → ↑ amniotic fluid osmolality (Ross MG. 1990) (Schreyer P et al. 1990) (Ross MG et al. 1988) |
| ↓ amniotic fluid volume → ↓ fetal movement via ↑ constriction (Moessinger AC et al. 1987) also → impaired fetal lung development (Cho FN et al. 2015) |
| ↓ brain angiotensin system which contributes to dipsogenic changes (Zhang H et al. 2011) |
| ↑ risk for umbilical cord compression → ↓ O ₂ delivery to fetus → ↑ acidemia (lowered pH) (Schreyer P et al. 1990) (Gur ED et al. 2016) (Bastian TW et al. 2016) (Myers RE. 1975) |
| ↑ risk for deep vein thrombosis (DVT) (Lock C et al. 2010); lethal renal venous thrombosis (Byard RW, 2019) |

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