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Association between Maternal Omega-3-Fatty Acid and Hypothyroidism: Unhealthy Baby and Brain Disorders

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COMMENTARY

Maternal diet and programs of gestational nutrition, in particular, omega-3 fatty acid may be crucial for a successful pregnancy, delivery, fetal, neonatal and child health outcomes (Greenberg et al., 2008; Sinha et al., 2009; Osendarp, 2011; Klemens et al., 2012; Swanson et al., 2012; Akerele and Cheema, 2016; Nordgren et al., 2017). Also, the normal levels of omega-3 fatty acid can regulate and protect the developing central nervous system (CNS) (Farquharson et al., 1995; Su et al., 1999; Bowen and Clandinin, 2005; DeMar et al., 2005; McNamara and Carlson, 2006). Accordingly, timely maternal thyroid hormones (THs; 3,5,3'-triiodothyronine (T3) and thyroxine (T4)) signaling is critical for the CNS development during the prenatal and postnatal periods (Ahmed, 2011, 2012a,b, 2013, 2014, 2015a-c, 2016a-d, 2017a-v, 2018a-w; Ahmed and Ahmed, 2012; Ahmed et al., 2013a,b, 2014, 2015a,b, 2018a,b; Van Herck et al., 2013; Ahmed and El-Gareib, 2014; Incerpi et al., 2014; Candelotti et al., 2015; De Vito et al., 2015; El-Ghareeb et al., 2016; Ahmed and El-Gareib, 2017).

On the other hand, there are associations between the amount and quality of gestational dietary fats and health consequences of both dams and their offspring (Makrides et al., 2011; Emmett et al., 2015). Omega-3 fatty acid supplementations have vital roles during pregnancy and can decrease the maternal brain disorders and the maternofetal and neonatal complications, and enhance the neonatal neurocognitive consequences (Olsen et al., 2007; Emmett et al., 2015; Miyata and Arita, 2015; Lauritzen et al., 2016), and visual insight (Uauy et al., 2003; Makrides et al., 2011; Campoy et al., 2012). Alternatively, my group reported that gestational hypothyroidism in rat caused several permanent disorders in the developing CNS including neuronal necrosis and apoptosis in different brain regions (Ahmed et al., 2008; 2010; 2012; El-bakry et al., 2010; Ahmed and Incerpi, 2013). These disorders are categorized by increased mitochondrial disorders including induced expression of pro-apoptotic protein Bax and diminish in anti-apoptotic Bcl-2 and Bcl-x_L proteins (Singh et al., 2003; Sadamatsu et al., 2006; de Escobar et al., 2007; Opazo et al., 2008). These disruptions can increase the risk of numerous neurodevelopmental diseases. Thus, dietary Omega-3 fatty acid intake during the gestation can prevent apoptosis decreasing the pro-apoptotic protein Bax and increasing anti-apoptotic Bcl-2 and Bcl-x_L proteins (Lonergan et al., 2002; Akbar et al., 2005; Rao et al., 2007; Mukherjee et al., 2007).

In conclusion, the current overview supposed that the normal balance in the levels of dietary omega-3-fatty acids (anti-inflammatory actions) and maternal THs may be necessary for the normal brain development during the prenatal and postnatal periods. In addition, the deficiency in their levels during the gestation may increase the risk of teratogenic consequences and brain disorders (depression, psychotic symptoms, mental retardation, schizophrenia, Alzheimer, cognitive dysfunction, and mood disability) in fetuses, neonates, and childhood. These disturbances may increase the susceptibility of the CNS to the inflammatory-immune diseases, may decrease the neurite growth, and may inhibit the development generally. However, their developmental, molecular and biochemical mechanisms are unclear until now. The disruptions in the fetal and neonatal development may be depending on the time and

severity of these deficiencies. Thus, this report can be recommended the following: **(1)** avoid the deficiency in levels of dietary omega-3-fatty acids and maternal THs; **(2)** Pregnant can keep the normal levels of dietary omega-3-fatty acids by eating the fatty fish such as salmon, tuna, and trout; **(3)** overconsumption of fishes should be avoided for the mercury toxicity; and **(4)** following the levels of maternal THs before or during pregnancy to decrease or avoid the previous disorders. Additional experiments are important to study the influence of the deficiency in levels of dietary omega-3-fatty acids and maternal THs at different stages of pregnancy (following pregnancy duration and birth dimensions) on the developing neuroendocrine system of both fetuses and neonates. The developmental, molecular, biochemical and immunological mechanisms should be examined. This could support development novel therapeutic approaches and enhance maternal and infant health consequences.

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