Saskatchewan
Early Childhood Mental Health
Provincial Network

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**Mental health in infancy and early childhood affects every aspect of individuals' lives throughout their lifetime, including social functioning, psychological well-being, and physical health.**

# Prenatal Nutrition and Early Brain Development

In human babies, the development of the brain begins prenatally. Brain development begins in the embryo, during the period after implantation. The first part of the embryo to develop is the spinal tube. This tube later closes and develops into the brain and the spinal cord, the two parts of the Central Nervous System. During the first trimester, synapses in the spinal cord are formed and create early neural connections. These result in the baby's movement. Even though the mother may not be able to feel movement this early, the baby begins moving as early as the 6th week after conception.

By the end of the second trimester, the brain stem is almost fully matured. This is the area of the brain responsible for instinctual, reflexive functions that are needed for survival. This includes breathing, sucking, swallowing, and blood pressure. The cortex, the part of the brain responsible for higher level thinking, is the last to develop. This begins in the third trimester and does not finish until post gestation.

A number of studies have focused on the impact of prenatal nutrition on the development of the fetus, in particular on early brain development. While there are some studies with human subjects, the vast majority use animals. Further studies are needed focusing on the impact of many nutrients, both micro and macro.

Despite the need for further research, there is significant information on the impact of deficiencies of iron, zinc, iodine, copper, and protein on the development of the fetal brain. It is important to note that all nutrients are important during fetal development; not just the ones referred to here (Wachs, Georgieff, Cuisick, & McEwen, 2014).

In summary, the following impacts of micro-nutrient deficits have been seen (Wachs et al., 2014):

- Iron deficits during the last trimester are associated with impacts to the myelin, striatum, and hippocampus. The striatum is part of the forebrain (thalamus, hypothalamus, and some of the cerebral cortex) and helps to coordinate motivation and body movement. The hippocampus is part of the limbic system and plays a role in long term memory and spatial navigation. Lastly, myelin is a sheath that wraps around the axons of neurons and aids in the communication speed of the neural network.

- Zinc deficits during the last four months of pregnancy have been associated with impacts to the autonomic nervous system, cerebellum, and hippocampus. The autonomic nervous system is part of the peripheral nervous system and controls involuntary functions such as breathing, heart rate, digestion, and perspiration. The cerebellum plays a role in motor control, coordination, attention, and fear and pleasure responses.

- Iodine deficits during the first and third trimesters are associated with impacts to the cortex, striatum, cerebellum, and hippocampus. The cortex is one of the highest functioning areas of the brain and is one of the last to develop. It is commonly known as the "thinking part" of the brain.

- Copper deficits during the last trimester are associated with impacts to the occipital and parietal lobes, striatum, cerebellum, and hippocampus. The occipital and parietal lobes are part of the cortex. The occipital lobe has a role in sight and the parietal lobe integrates sensory information and has a role in spatial processing.

- Protein deficiencies during pregnancy are associated with overall impacts to brain development as well as specifically to the hippocampus, striatum, and hippocampus.

The above points provide a summary of the areas impacted by deficiencies in these nutrients on brain development; however, it can be useful to have a more detailed understanding of how nutrients are used by the body and how deficiencies impact development overall. To do this the remainder of this newsletter will focus in more detail on the importance of iodine and iron during pregnancy. For more detail on the importance of the other nutrients highlighted above go to http://tinyurl.com/p93bucw.

**Iodine Consumption during Pregnancy**

Iodine is associated with thyroid function. Thyroid function has been associated with regulating energy, growth and development. Hormones that are secreted by the thyroid are associated with brain development and function.

During pregnancy there is an increased need for iodine. There are many reasons for this including increased maternal thyroid production and transfer of iodine to the fetus. If a woman is deficient in iodine before pregnancy, it will be difficult to make up the extra amount needed during pregnancy (Zimmermann, 2011).

Adequate levels of iodine are particularly important in the first trimester when the mother shares thyroid secretions with the fetus. In the second trimester, the fetus begins secreting thyroid hormones and adequate iodine levels between both the mother and the fetus are equally important for development.

Deficiencies in maternal iodine can lead to fetal? hypothyroidism in utero. It is hypothesized that from the first trimester and onward central nervous system (CNS) development may be sensitive to thyroid hormone deficiencies. In the fetus, iodine deficiency impairs myelination, and cell migration, differentiation, and maturation (Benton, 2008; Wachs et al., 2014; Zimmermann, 2011). Neurons differentiate or specialize based on the function they will end up playing. Once immature cells have differentiated during the embryonic period, they migrate to the area in the body where they will function. At this point, they mature. If there is an iodine deficiency, each of these stages of CNS development can be impacted.

Pregnant women should consume between 220 mcg—1100 mcg of iodine per day. The Dieticians of Canada have information on their website about natural sources of iodine. Please follow http://tinyurl.com/kxcfnd7 for more information.

**Iron Consumption during Pregnancy**

Iron helps to carry oxygen throughout the body, is a component of muscles, and helps to regulate the growth of cells. Iron deficiency can cause dizziness, loss of breath, headaches, and sores in the mouth (University of Rochester, 2014). The last trimester of pregnancy is a critical period for iron consumption, as it impacts both the mother's health and fetal development (Georgieff, 2011).

Maternal iron deficiency has been associated with increased rates of maternal depression. During the last trimester, increased anxiety and stress can be an

indicator of maternal depression. Prenatal stress is related to shorter telomeres in the fetus (Wachs et al., 2014).Telomeres are the "caps" at the end of chromosomes and shortened telomeres are associated with chromosome instability and deterioration (Clinical Chemistry, 2014).

As well, iron deficiency during pregnancy has an impact on brain maturation. Low umbilical cord iron levels have been associated with later deficits in auditory language comprehension (Black, Quigg, Hurley & Pepper, 2011). Iron deficiency in utero can also lead to long term changes in dopamine metabolism, myelination, and hippocampal function (Georgieff, 2011).

Pregnant women should consume between 27 mg - 45 mg of iron per day. The Dieticians of Canada have information on their website about natural sources of iron. Please follow http://tinyurl.com/psd4zgq for more information.

Supporting mother's to have adequate nutrition, especially when food security is a concern, is one way that we can ensure optimal fetal development. Pregnancy is a critical period for the development of the brain. Although this development is continued throughout development, the prenatal period sets the foundation for this.

**References**


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# Professional Development Opportunities

## Prevention Matters 2015
## For Children, Families, and Communities

September 30 – October 2, 2015
TCU Place, Saskatoon, SK

Registration opens in February 2015.

**CALL FOR ABSTRACTS**

All abstract submissions are due January 15, 2015.

http://www.skprevention.ca/prevention-matters-2015/#Call%20for%20Abstract

**RIRO Resiliency Training**
***Ile a La Crosse, SK***
***March 17-18, 2015***
Contact: Liz.Durocher@kyrha.sk.ca

**2014 SK Conference on Children and Adolescence**
***Travelodge Hotel***
***Saskatoon, SK***
***November 24-25, 2014***
Registration: $439.00
To register, go to http://www.jackhirose.com/workshop/the-2014-saskatchewan-conference-on-children-and-adolescents/

**Teaching Social Thinking Through Stories and Play to Early Learners**
***Fort Gary Hotel, Winnipeg***
***November 13-15, 2014***
Registration: $425.00
To register, go to www.childcare2020.ca

**Violence Prevention**
***Free Online Course***
***Offered through Emory University on behalf of the World Health Organization's Collaborating Centre for Epidemiology and Control***
To register, go to: www.coursera.org/course/violence

**Saskatchewan Early Childhood Association**
**Nov. 22 Play and Explore**
**Dec. 1 Responding to Children's Interests (Part 1)**
**April 16 Responding to Children's Interests (Part 2)**
Must be a member
http://seca-sk.ca/calendar/

**MotherFirst Maternal Mental Health Conference**
**Regina, SK**
**May 7 –8, 2015**
Registration open early 2015
https://sites.google.com/site/maternalmentalhealthsk/

**Please feel free to distribute this information to others. If you or someone you know is interested in participating in the ECMH Provincial Network, please contact Lee Hinton at lhinton@skprevention.ca.**

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