Folate/ Folic Acid and Spina Bifida Prevention

By Brandon L. Lee

Pregnancy is one of the most important times in a woman’s life and equally as important for the baby who is growing in her. Pregnancy is one of the most carefully monitored times in a woman’s life. Nutrition, exercise, general health, environment, genetics, stress, sleeping patterns and knowledge of all these aspects of health all affect a woman during pregnancy. Some of the main nutrients of concern during pregnancy include calcium, iron, choline, iodine and folate (Brown, 2014). Folate deficiencies in recent times have decreased due to fortifications and awareness. Folate deficiencies have been linked to neural tube defects; most notably spina bifida. Spina bifida can cause learning disabilities, nerve damage, paralysis of lower limbs and encephaly. Every year 1,500 babies are born with spina bifida (Data, 2014). Infants with spina bifida have been shown to have folate deficiencies compared to infants without spina bifida.

Spina bifida is also known as myelocoeles. Spina bifida is the result of a fusion failure of the caudal neural tube during the sequence of events known as neurulation. Spina bifida is one of the most common malformations of the human body structure (Mitchell, 2004). The malformation affects the spinal cord, vertebrae and skin. Causes of myelocoeles are believed to be chromosome abnormalities, single gene disorders, teratogenic exposures, disturbances in cell adhesion, alterations in the neural plate forming, and bending that will stop apposition of the neural folds (Mitchell, 2004). Family history seems
to be one of the most important risk factors for this disorder; and at birth, it is more prevalent in girls than boys. Maternal diabetes is a risk factor for having a child born with spina bifida. Mothers having pregestational diabetes who become pregnant have a tenfold higher risk of having a child born with spina bifida compared to general population of pregnant women (McLeod, 2002).

In addition to genetics and diabetes, studies show that valproic acid or carbamazepine separate or used in combination can increase risk for spina bifida (Lammer, 1987; Hernandez-Diaz, 2001; Matalon, 2002). Most often valproic acid or carbamazepine are used for bipolar disease, chronic pain or migraines (Mitchell, 2004). Other risk factors of fetal spina bifida are maternal obesity, hyperinsulinaemia, chlorination disinfection by-products in drinking water, electromagnetic fields, hazardous waste sites and pesticides (Hendricks, 2001; Klotz, 1999; Dodds, 2001; Blaasaas, 2002; Orr, 2002; Dolk, 1998). Current practices dictate to do maternal serum α-fetoprotein and ultrasound testings during pregnancy to predict whether or not the infant is developing or has spina bifida in-utero (Drugan, 2001). If a fetus is not electively terminated it will not receive any form of treatment until after the birthing. In-utero treatment methods are being studied and eventually these could become an option for fetuses with spina bifida.
Folate, also known as vitamin B9, has several roles in the body of the mother and the fetus. The roles of folate include making new cells and tissues (e.g. intestines, skin, embryonic and fetal tissues), and synthesizing DNA and keep normal metabolism of many amino acids (Sizer, 2012). In addition, folate works with vitamin B12 to produce red blood cells and keep homocysteine levels low (Grosvenor, 2012). The other form of folate is folic acid which is the form not found in food but in capsules. Folic acid is more easily absorbed and is used in dietary supplements and fortified foods.

The RDA of folate is expressed in dietary folate equivalents (DFE). Considering that folic acid is more bioavailable than folate the DFE corrects for differences between the two. The current research states that 1 microgram of folate equals 0.6 micrograms of folic acid (supplement or fortified food), which also equals 0.5 micrograms of folic acid if on empty stomach. The current recommendations for a pregnant woman or women trying to become pregnant is 400 micrograms from folate and another 400 micrograms from a synthetic source per day (i.e. folic acid) (Grosvenor, 2012). Toxicity levels stand at 1,000 micrograms per day. Exceeding this limit will lead to suppression of immune system, increase cancer risks and masks vitamin B12 deficiency symptoms (Sizer, 2012). Folate is found in ...
Folate and vitamin B12 complement each other in achieving necessary tasks for the fetus and mother. They work together to create red blood cells and with the help of vitamin B6 all three of them keep homocysteine levels from going too high. High homocysteine levels have been related to cardiovascular disease and increase risk for Alzheimer’s disease. Moreover, deficiency of vitamin B12 prevents folate from being converted into an active form that the body can use (Grosvenor, 2012). Deficiency of folate in the mother’s diet can result in anemia, smooth, red tongue; depression, weakness, fatigue, headache mental confusion, poor growth, nerve development and function issues and diarrhea (Sizer, 2012).

Up to 70% of spina bifida cases can be prevented by proactive intake of folate/folic foods or supplements (Mitchell, 2004). In a study that was conducted by the UK Medical Research Council, mothers supplemented with 4 mg of folic acid per day showed a three-fold reduction in NTD recurrence risk (Mitchell, 2004). In one research study the result reinforced the idea that folate supplementation is beneficial. The study suggested that maternal auto-antibodies bind to the folate receptors and block the uptake of folate, causing NTDs. Moreover, another study had showed that prepregnancy weight and neural tube defects observed that folic acid supplementation offered only some protection for women weighing less than 70kg (154 lbs.) but none for women any heavier (Werler, 1996). The amount of supplementation was not stated. Whether or not the amount of folic acid
provided to mothers whom are expecting is little or great the benefits still potentially remain the same.

In 2013, a study was done using a food frequency questionnaire (FFQ) to determine the folate/folic acid intake of women who recently gave birth. This study was based around the association between the impact of folate acid intake and obesity, diabetes and spina bifida. The FFQ asked women what their diet was like six months prior to being pregnant. The folate acid intake was assessed by calculating the average daily intake from supplements and food sources. One result of the study revealed “The joint effect of low folate acid intake and preexisting diabetes mellitus resulting 4-fold increased risk for spina bifida... relative to mothers without diabetes mellitus and with higher daily folate acid intake, which was greater than expected given the individual additive effects of low folate acid intake and pre-existing diabetes mellitus.” (Parker, 2013). In addition, the study explained that obese women who take the recommended amount of folate/folic acid daily are at just as much risk for the their baby being born with spina bifida as if they didn’t take it at all due to their obesity (Parker, 2013).

In 1998 the fortification of folate become mandatory in the United States and since then national improvements have been shown; like infants with less NTDs, fully growth brains, fully functional limbs and more. Food items that have been fortified since 1998 include but are not limited to flour,
breads, rice, noodles, cereals and corn meals. There has since been a decrease in NTDs by 19% (Honein, 2001). More specifically this translates to a decrease of 31% of spina bifida cases (Williams, 2002; Canfield, 2005). These statistics are significant for America but this positive movement has spread globally. In Australia and New Zealand in June 2007 mandatory fortification of 200-300 micrograms of folic acid per 100g of wheat flour was implemented (Oddy, 2007). Fortification of the foods list above and many others can help mothers across America benefit the children in the long run without even needing to try. Although fortification is not enough, education must also be applied for long-term success.

Women, Infants and Children also known as WIC helps women, infants and children (up to age five) of low income by providing nutrition education, supplementation and health care referrals. WIC has been helping low income moms since 1974 and continues to do so (WIC, 2014). Knowledge is power, and by providing knowledge for mothers there can be a domino effect. One mother can learn and then teach other mothers, and then they can teach other mothers too. Now this domino effect can also help the fathers as well or the grandmother or anyone who may be helping mom
along her pregnancy. Obstetrics and gynecology (OB/GYN) doctors are professionals in their respective field and all mothers should make regular visits but only Registered Dietitians can truly help an expecting mother or anyone for that matter in the world nutrition. Through maternal, periconceptional folic acid supplementation alone 70% of spina bifida cases can be eliminated (Mitchell, 2004).

1 in 1,000 births result in spina bifida (Blom, 2006). Infants with spina bifida have been shown to have folate deficiencies compared to infants without spina bifida. Folate functions include making new cells and tissues (e.g. intestines, skin, embryonic and fetal tissues), and synthesizing DNA and keep normal metabolism of many amino acids (Sizer, 2012). It is recommended that women who are trying to become pregnant or are pregnant take in 400 micrograms of folate and 400 micrograms folic acid per day. Spina bifida is a posterior NTD that is caused by the failure of the neural tube to come together at the caudal end (Blom, 2006). Spina bifida can prevented through supplementation, consumption of fortified foods, education and use of government resources (e.g. WIC, USDA, AND). Despite the amazing studies conducted on folate and spina bifida prevention the mechanism by which it works is still unknown and being researched every day.
References:


