

Neural Tube Defects: Implication for Foods and Nutrition Education

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ABSTRACT

This paper has been able to discuss the neural tube defect, the causes which include folic acid and maternal diabetes, the concept of foods and nutrition education and the foods that are rich in folate, the required recommended daily intake for normal, pregnant and lactating mothers. On this note, the paper made some suggestions which include: Food and Nutrition lecturers should encourage their students of child bearing age and the general public to consume foods containing good sources of folate before and during pregnancy, since folic acid is needed for development before the mother is even aware of her being pregnant. And secondly, the federal and state governments should impose a mandatory fortification of grains and other food sources with Folic Acid concentrates like that of iodine and vitamin A as a way of improving the primary preventive efforts and this will result in a significant decline in the incidence of NTDs in country.

Key words: neural tube, neural tube defects, foods and nutrition education, folic acid

INTRODUCTION

Food is essential to life; it provides the nutrients necessary for growth, development and health maintenance. Modern human's nutrient requirement is an outcome of millions of years of evolution, as human physiology has adapted to available food supplies. Although, it is not possible to be sure whether the amount and consumption of available food supplies has been optimal for health as the environment changed over centuries, it evidently has been adequate for human survival until child bearing age (Mark, 2013). The relatively recent global epidemic of diet-related non-communicable diseases, such as cardiovascular diseases, cancer, and type 2 diabetes has been attributed in part to contemporary nutrient intake patterns that depart from those that have existed for much of human evolution along with social and environmental pattern, such as changes in physical activity. Specifically, it seems that the rate of change in nutrients intake over the past hundred years has occurred more rapidly than the genes that shape our physiology have been able to evolve and adapt (Rahji and Rahji, 2014). Mark (2013) further opined that throughout history, the inter-relationship between human physiology and available

food supplies has taken place within an ecological setting that has mediated the availability and nutrient composition of individual foods. On this note, the paper will be looking at the concept of food and nutrition education, nutrition, neural tube defects and the role nutrition education could play to reduce NTDs occurrence.

Concept of Food and Nutrition Education

Food and Nutrition education is defined as “any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition-related behaviours conducive to health and well-being”. Nutrition education is delivered through multiple venues and involves activities at the individual, community and policy levels (Contento, 2011). Foods and Nutrition Education consists of a variety of educational strategies that can be implemented at different levels, aimed at helping people to achieve long-lasting improvements in their diets and eating behaviours (Stone, 2014). Nutrition is the study of how the body uses the nutritive substances or nutrients contained in foodstuff. According to Drummond and Brefere (2010) nutrition is the science that studies nutrients and other substances in foods and in the body and the way those nutrients relates to health and diseases. Nutrition refers to both the outcome and process of providing the nutrients needed for health, growth, development and survival (Rahji and Rahji, 2014). According to Food and Agriculture Organization of the United Nation (2016) Foods and Nutrition is all about the following:

- ∞ Empowering people to take charge of their own diets and health.
- ∞ Building on people’s desire to be healthy, know more about diets, and eat good food.
- ∞ Understanding people’s needs and what influences their diets.
- ∞ Carrying out realistic and participatory educational activities.
- ∞ Aiming at small, appealing, do-able improvements in what people perceive and do.
- ∞ Engaging all people who can help or hinder dietary changes.
- ∞ Including all relevant sectors and strengthening their capacities.

- ∞ Influencing decision makers to implement policies which promote healthy diets.
- ∞ Advocating for improvements in the food environment to enable healthy food choices

Foods however, are a combination of macro and micro nutrients which include: carbohydrates, protein, fats, mineral salt, water and vitamins. Food nutrients are nourishing substances that provide energy and promote the growth and maintenance of the body (Drummond and Brefere, 2010). Each nutrient class performs different functions in the body. The body needs carbohydrates, proteins and fats or lipids in large amount and so are called macronutrients. In the contrast, vitamins and minerals are needed in small amount and so these nutrients are known as micronutrients. The macro and micronutrient form the essential nutrients in foods which the body cannot manufacture on its own that must be provided by diet consumed. These essential nutrients include some forms of glucose, mineral, water, some lipids, some parts of protein and vitamins. There are about 13 different types of vitamins which are organic nutrients or substances found in food that regulate body processes, maintain the body, and allow growth and reproduction. These vitamins both fat and water soluble in nature and they include; fat-soluble vitamins (vitamin A,D, E, and K) while water soluble vitamin are; vitamin C and B. (thiamin, riboflavin, niacin, vitamin B6, vitamin B12, Pantothenic acid, Biotin Choline and Folate or Folic acid etc (Drummond and Brefere, 2010)

Folate is a generic term for a water-soluble B complex vitam that serves as an essential coenzyme in single –carbon transfers in the metabolism of nucleic and amino acids and thus fills an important function in purine and pyrimidine metabolism. Folic acid is the form of folate found in vitamin supplements and fortified foods. Folate occurs in certain natural foods as polyglutamate, a form less absorbed than free folate. Folic acid is a monoglutamic acid that is the oxidized and most active form of the vitamin found rarely in foods and it is the form used in vitamin preparation and food fortification. Folate is needed for healthy pregnancy by making blood cells and to help baby growth and in any case of deficiency may lead to malformation of the foetus known as neural tube defects.

Neural Tube Defects (NTDs)

Neural tube defects (NTD) are common major congenital anomalies that result from very early disruption in the development of the brain and spinal cord. Neural simply means connected with a nerve. Wardlaw and Hampl (2007) stated that very early in fetal development, the ridge of neural like tissue forms along the back of the embryo and as the fetus develops, this material differentiates into the spinal cord and body nerves of the lower end and into the brain at the upper end. At the same time, bones that make up the back gradually surround the spinal cord on all sides. Whitney and Rolfes (2008) defined neural tube as the embryonic tissue that forms the brain and spinal cord. Jones and Imran 2010 refer to neural tube defect as the incomplete closure of the neural tube in very early pregnancy and that it comprises of a bundle of nerve sheath which closes to form brain at the anterior and spinal cord at posterior end. Whitney and Rolfes further explained that, the neural tube is the beginning structure of the brain and spinal cord, and any failure of the neural tube to close or develop normally results in central nervous system disorders. This malformation of the brain and spinal cord or both, during embryonic development often results in life - long disability or death is known as Neural Tube Defect.

Neural tube defects (NTDs) occurs when the tube fails to close properly (Whitney, Debruyne, Pine and Rolfes, (2007) and Jones and Imran (2010). The authors further opined that, neural tube defects arise early in pregnancy before most women realizes that they are pregnant. And that the brain and spinal cord develop from the neural tube. The defects in its orderly formation during the early weeks of pregnancy may result in various central nervous system disorder and death. Similarly, Wardlaw and Hampl (2007) opined that neural tube defects result from a developmental failure affecting the spinal cord or brain in the embryo. Neural tube closure begins in the 21st day after conception and is completed by the 28th day, a time when many women are not aware that they are pregnant. Neural tube defects manifest it in three major types as:

Spina Bifida (split spine or spinal cord have one or more openings in the middle)

Anencephaly (no brain)

Encephalocele (protrusion of brain tissue or its covering membranes through a defect in the skull)

In anencephaly, the upper end of the neural tube fails to close. Consequently, the brain is either missing or fails to develop. And pregnancies affected by anencephaly often end in miscarriage. Infants born with anencephaly die shortly after birth. Spina bifida is characterized by incomplete closure of the spinal cord and its bony encasement. The meninges membranes covering the spinal cord often protrude as a sac and sometimes a portion of the spinal cord is contained in the sac, which may rupture and lead to meningitis, a life – threatening infection. Spina bifida is accompanied by varying degrees of paralysis, depending on the extent of spinal cord damage (Wardlaw and Hampl (2007), Whitney et al (2007), and Whitney and Rolfes, 2008). The authors further stated that mild cases may not even be noticed, but severe cases lead to death, but moderate cases may involve clubfoot, dislocated hip, kidney disorders, curvature of the spine, muscle weakness, mental handicaps, motor and sensory losses and other ills. The incidence of neural tube defects (NTDs) in developing countries has been reported to be up to four-fold higher than in developed ones (Cherian, Seena, Bullock and Antony (2005) and Ren, Zhang, Li, Hao and Tian, 2006).

The life-long medical and socio-economic consequences of NTDs in affected children are equally known to be worse in low-resource settings. The mechanisms which cause NTD are still not fully understood, but evidence has shown that increased intake of folic acid during the periconceptual period can decrease the prevalence of NTD (Abeywardana and Sullivan, 2008). Wardlaw and Hampl (2007) and Whitney et al (2007) further opined that, perhaps as many as 70% of these defects could be avoided by adequate folate status before conception.

Deficient folate (folic acid) status in the mother during the beginning of pregnancy increases the risk of neural tube defects, as does a genetic disposition (Wardlaw and Hampl, 2007). According to healthdirect (2012) adequate folate levels are critical during the early days of the developing embryo, particularly, the third and fourth week. It is this period that neural tube defects occur. Similarly, Whitney and Rolfes (2008) also observed that, successful development of the neural tube depends, in part on the vitamin folate. Folate plays an important role in preventing neural defects. The early weeks of pregnancy are critical period for the formation

and closure of the neural tube that will later develop to form the brain and spinal cord. And by the time, the woman suspects she is pregnant, usually around six weeks, the embryo's neural tube normally has closed (Wardlaw and Hampl (2007), Whitney et al (2007), and Whitney and Rolfes, 2008). Folic acid taken by women at least four weeks prior to conception and throughout the first trimester of pregnancy, or periconceptional Folic Acid intake, has been associated with up to 80% reduction in the incidence of NTDs (Medical Research Council (1991) and Czeizel and Dudas, 1992). Early exposure in pregnancy to Folic Acid has also been found beneficial in the prevention of some other reproductive mishaps like congenital heart diseases, cleft lip and palate, limb defects and anorectal malformations (McDonald, Ferguson, Tam, Loughheed and Walker (2003) and Eghwrudjakpor, Amadi and Amusan, 2011) .

In developing countries, the absence of pre-conceptional counseling coupled with sub-optimal antenatal care services is a barrier to reducing the incidence of NTDs (Adeleye, Dairo and Olowookere, 2010). In the view of Taiwo and Amos (2014), the level of awareness and usage of folic acid is low despite the knowledge that Folic Acid has benefits as a haematonic.

Folic acid or folate has been well known for a number of years that sufficient folate in the mother's diet will reduce the chances of her baby having spina bifida by up to 70%.

Neural Tube Defects and Foods and Nutrition Education

Adequate knowledge of nutrition is required to reduce the incidence of neural tube defects as other factors constitute risk. Jones and Imran (2010) emphasized folic acid deficiency and maternal diabetes as the major cause of NTDs. The authors further explained elevated maternal serum alpha-fetoprotein (MSAFD) levels and elevated amniotic fluid acetylcholinesterase (AChE) levels as markers. Similarly, Health direct (2012) emphasized that all women of childbearing age should ensure that they are consuming sufficient folate or folic acid and that, there are other factors that can make a mother be at increased risk which includes:

- ∞ Close family history of neural tube defects

☞ If parents have spina bifida, the risk is greater about one in every four, but if one parent had it, the risk increases 20 times to about one in every twenty-five.

☞ Maternal diabetes

☞ Maternal intake of some antiepileptic medications, especially those containing sodium valproate or valproic acid.

All women of child bearing age (for instance 14 – 50 years) need to eat foods that are high in folate and also take a supplement with 400microgram or 0.4mg of folic acid every day. To reduce the baby's risk of being born with a neural tube defect, the mother's diet must contain sufficiently high level of folate before the pregnancy and while still pregnant, especially the first three months (Healthdirect, 2012). According to Drummond and Brefere (2010) the recommended daily requirement of folic acid for pregnant women is at least 600 microgram of folate per day from foods and supplements. Breastfeeding women need at least 500 microgram of folate each day also from foods and supplements.

As mentioned earlier, folate occurs naturally in foods and good sources of folate include:

☞ Cooked dried beans, kidney beans, chick beans, peas, lentils and green soybeans.

☞ Dark green vegetables such as asparagus, cabbage, okra, avocado, spinach, broccoli, romaine lettuce, beet, green peas, brussel sprout, gailain and bokchoy

☞ Oranges and orange juice, guava, tomatoes, walnuts.

☞ Whole wheat germ, whole wheat bread, whole wheat flakes, wholegrains, somelina, brown rice, millets, sunflower seeds, yeast extract like marmite and peanuts.

☞ Liver and liver products (e.g liver wurst spread and liver sausages) are high in folate, as well as very high amount of vitamin A. too much of vitamin A may cause birth defects, especially during the first trimester. The safest choice is to limit the consumption of liver and liver products during pregnancy. Where one wish to eat them, should have not more than 75g (2¹/₂ ounces) per week.

Conclusion

This paper had been able to discuss neural tube defects (NTDs) as a malformation that occurs, when the tubes fails to close properly in the foetus as a result of folic acid deficiency, which arise early in pregnancy before most women realize that they are pregnant within the first three weeks of conception. The brain and spinal cord develop from the neural tube and its failure to close causes the malformation. The paper also discussed how the knowledge of foods and nutrition education could ameliorate folic acid deficiency by consuming foods rich in folate before pregnancy, during pregnancy and lactation.

Recommendations

Based on the above, the following suggestions are made:

1. Food and Nutrition lecturers should encourage their students of child bearing age and the general public to consume foods containing good sources of folate before and during pregnancy, since folic acid is needed for development before the mother is even aware of her being pregnant.
2. The federal and state government should impose a mandatory fortification of grains and other food sources with Folic Acid programme like that of iodine and vitamin A as a way of improving the primary preventive efforts and this result in a significant decline in the incidence of NTDs in country.
3. Women of child bearing age and pregnant mothers should be encouraged to live a life of diabetes free as maternal diabetes causes neural tube defects in foetus by choosing wisely the kind of foods they eat such as nutrient dense foods and not energy dense meals, for energy dense meals lead to diabetes.
4. The Federal and State government should organize enlightenment programme for women of the state and nation. This will enable them to prevent the causes of neural tube defects (spina bifida).
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