Nutritional Supplementation and Fetal Alcohol Spectrum Disorder

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Issue:

Fetal Alcohol Spectrum Disorder (FASD) is an umbrella term used to describe the range of disabilities and diagnoses that can result from prenatal exposure to alcohol. Maternal nutrition can often be compromised when alcohol is consumed, especially in situations of chronic alcoholism. Poor overall nutrition may contribute to and/or compound the effects of prenatal alcohol exposure. Recent evidence from preclinical studies suggests that pre- or postnatal nutritional supplementation may improve neurocognitive function (e.g., learning, memory) and behaviour. Thus nutritional supplementation may be an accessible method for improving maternal and fetal pre- and postnatal health.

Background:

Fetal Alcohol Spectrum Disorder (FASD) is the most common preventable neurodevelopmental disability worldwide, with lifelong consequences for both affected individuals, their families and society. Specific evidence regarding the absolute safe level of alcohol intake during pregnancy cannot be established. For this reason, most guidelines recommend abstinence from alcohol for all women who are pregnant or who are trying to become pregnant [1]. At present, interventions available for children with FASD are behavioural and educational support, with specific drugs prescribed for comorbidities such as attention deficit hyperactivity disorder [2, 3]. These interventions attempt to overcome the functional deficits resulting from organic brain injury in individuals with FASD and can improve cognitive function.

New pre-clinical data suggest that decreased maternal vitamin, mineral and antioxidant (i.e., agents that protect the body from damage) status may exacerbate the effects of prenatal alcohol exposure on the developing fetus [4]. Associated factors arising from poor maternal nutrition may contribute to the degree of damage induced by prenatal alcohol exposure. Alcohol can replace daily food consumption, leading to an overall decline in nutrient intake. It can also disturb gastrointestinal function, leading to reduced or enhanced absorption of vitamins and minerals, and affect the absorption of zinc. Zinc is needed to help breakdown alcohol, and decreased concentration can affect the body's ability to clear alcohol from the blood stream. Mobilization of vitamin A from the liver may increase with excessive alcohol consumption leading to toxicity and potential birth defects. Alcohol consumption increases metabolic demands and impairs utilization of nutrients. Polydrug use can also be problematic, as alcohol consumption can co-occur with cigarette smoking and other drug use, which may also adversely affect the developing fetus.

Exposure to alcohol during pregnancy decreases brain concentrations of omega-3 fatty acids and choline. Omega-3 fatty acids and choline are essential for healthy pre- and postnatal brain development. Omega-3 fatty acids have anti-inflammatory and antioxidant properties that help reduce cell death [5],

maintain normal brain function [5, 6] and contribute to learning and memory. Choline is also implicated in learning and memory, and plays an important role in overall brain health. Choline can also affect the way genes are expressed, which can influence normal growth and development. Depletion of these important nutrients can have long-lasting effects on brain circuits that are important for learning and memory.

Preclinical research Findings Related to Nutrition and FASD:

Preclinical studies demonstrate that postnatal omega-3 fatty acid supplementation can overcome long-lasting deficits in antioxidant protection and improve learning and memory [7, 8]. Choline supplementation to postnatal offspring can have beneficial effects on behaviour (e.g., improve working memory and associative learning, and decrease hyperactivity) when administered following prenatal alcohol exposure [9-12]. These findings suggest that prenatal alcohol-induced damage to the brain pathways that influence behaviour may be mitigated, at least in part, by postnatal nutritional supplementation. While preliminary, these findings highlight a potential treatment option for repairing the neuronal (brain) damage associated with FASD, which could lead to improved cognitive function.

One treatment strategy for improving the learning and memory deficits associated with FASD is a multi-supplement approach that combines omega-3 fatty acids, choline and other antioxidants such as vitamin E. These "Medical Food Cocktails" are currently under investigation as potential treatments for neurodegenerative diseases such as Alzheimer's disease, in which improvements in cognition have already been observed [13, 14]. The relationship between neurocognitive deficits associated with prenatal alcohol exposure and medical food cocktails is still unknown, but warrants further investigation.

Interestingly, voluntary exercise can alleviate the learning and memory deficits associated with prenatal alcohol exposure [15, 16]. Remarkably, the combination of voluntary exercise and omega-3 fatty acid supplementation had a synergistic effect that enhanced the production of chemicals (in the brain) that are beneficial for learning and memory [17]. By applying these same methodologies to the prenatal alcohol exposure situation, it may be possible that individuals experience these same benefits and can help to facilitate recovery.

Based on preclinical studies, the use of nutritional supplementation, such as omega-3 fatty acids, choline and vitamin E, appears to have positive benefits on cognitive function following prenatal alcohol exposure. Further research is required to determine the appropriate dosages and time courses in humans to determine whether these benefits exist into the clinical population. Even so, nutritional interventions may be a promising treatment approach to mitigating the neurodevelopmental dysfunction associated with FASD.

Recommendations:

- Provide training and educational opportunities for primary health care practitioners around nutrition, with a particular focus on prenatal health. These information sessions should encourage healthy eating habits and endorse the Canadian Food Guide [18].

- Identify a feasible and sustainable mechanism for ensuring food availability to high-risk communities. Many pregnant women fail to meet their basic daily nutritional requirements primarily due to lack of access to healthy foods.

- Improved messaging around nutrition and healthy brain development using a variety of marketing and social media tools could improve awareness. Endorse public health campaigns (e.g., community cooking programs) that encourage healthy eating habits.

- Engage with major relevant federal research funding institutes to discuss specific grant opportunities that investigate the benefits of nutritional supplements, either alone or in combination, for individuals with and without neurodevelopmental disorders (e.g., FASD). It is important to determine if the benefits observed in preclinical studies extend to the broader population.

- Develop best practice guidelines for health care practitioners that recommend increasing nutrient levels in pregnant women who do not meet the Recommended Dietary Allowances through their diet. Partner with pharmaceutical companies to develop a protocol for providing prenatal vitamins at no cost, for patients most at-risk and develop mechanisms to ensure that these women are receiving the support they need. For example, if utilization of nutrients is impaired by alcohol (and/or other substances) use independent of dietary intake, nutrient supplementation should be adjusted for pregnant women [19].

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