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Autism Linked to Bovine Milk-based Formulas Fed to Premature Infants

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Abstract

Human milk is uniquely optimized for the needs of the developing infant. Bovine milk-based preterm infant formulas are deficient in two vital nutrients required by the brain, with the consequence that extremely preterm-born children fed these formulas are at high risk of arrested brain development resulting in autism.

Keywords: *Autism, Pediatrics*

Introduction

Very premature infants can suffer cognitive impairment and atypical brain development resulting in autism **[1].** In a 2015 study at the Karolinska University Hospital in Sweden, almost 30 percent of extremely preterm-born children had developed symptoms of autism compared to only 1 percent of children born after full term pregnancy **[2, 3**].

Fetal Brain Development

The average pregnancy lasts 40 weeks. During weeks 26 to 29, short-range neuronal connections actively develop in the fetus. During weeks 30 to 33, areas for complex cognitive skills develop in the brain **[4].** Thus, an infant born prior to 26 weeks gestation is at risk from impaired brain development.

Preterm Infant Formulas

Bovine milk-based preterm infant formulas are inherently deficient in the brain nutrients, DHA and MFGM. Extremely preterm-born children who are deprived of these vital nutrients can suffer impaired brain development.

Docosahexanoic Acid *(DHA*) is an omega-3 fatty acid that is a primary structural component of the human brain and is obtained directly from maternal milk (breast milk) **[5**]. DHA in breast milk is required for the developing brain **[6**]. DHA deficiency is associated with cognitive decline **[7, 8**]. Mothers with optimal DHA status produce milk containing 1% DHA. Unfortunately, the DHA content of bovine milk-based preterm infant formulas ranges between 0.2 and 0.5%, which is on average only about one-third of what the brain requires for its optimal development **[9**].

Milk fat globule membrane (*MFGM*) is a bioactive structure that surrounds the fat globule secreted from the milk producing cells of humans and other mammals. Constituents of MFGM provide essential nutrients to the developing brain **[10, 11**]. Gangliosides in MFGM are required for neonatal brain development and cognition and become part of the grey matter of the brain **[12-14**]. Sphingolipids and glycosphingolipids in MFGM are required for brain development and neuronal survival and become part of the cell membranes of the brain and neuronal tissue **[15-16**]. Unfortunately, MFGM does not

survive the processing of bovine milk into the powder that is the major component of preterm infant formulas.

Necrotizing Enterocolitis (*NEC*)

In addition to providing structural components to the brain, the milk fat globule membrane (*MFGM*) also aids in the structural maturation of the intestines and in the shaping of the gut microbial populations which modulate intestinal immune response **[17**]. Because bovine milk-based preterm infant formulas are devoid of MFGM, many premature infants succumb to necrotizing enterocolitis (*NEC*), a devastating intestinal disease that has a 25 to 50% mortality rate **[18, 19**]. A common complication of NEC is developmental delay **[20, 21**].

NEC occurs as clusters of cases in neonatal intensive care units **[21**]. The odds of an infant developing NEC are directly related to the intensive care unit in which they are placed **[23-25**]. The most preterm infant is at highest risk of developing NEC.**[26**]

The Neurology of Autism

Autism is caused by a dysfunctional cingulate gyrus (*CG*), that part of the brain which focuses attention **[27-29**]. The apparent cause of autism in extremely preterm-born infants is arrested development of the CG resulting from being fed bovine milk-based preterm formulas that are inherently deficient in the vital brain nutrients, DHA and MFGM.

In a neurotypical brain, the cingulate gyrus acts like an automatic transmission that seamlessly switches attention back and forth between frontal lobes, as required. In autism, however, a dysfunctional CG keeps the person's attention perpetually trapped in his/her left frontal lobe (logical/analytical) with no ability to access the right frontal lobe (emotional/creative) that plays a central role in spontaneity, social behavior, and nonverbal abilities **[27-29**].

Conclusion

The apparent cause of autism in extremely preterm-born infants is arrested development of the brain's cingulate gyrus (*CG*) resulting from being fed bovine milk-based preterm formulas that are inherently deficient in the vital brain nutrients, docosahexanoic acid (*DHA*) and milk fat globule membrane (*MFGM*).

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