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Prenatal Environmental Toxins and Possible Links to Autism

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Introduction

Autism is a "neurodevelopmental disorder characterized by qualitative impairments in social interaction and communication, and by restricted repetitive and stereotyped patterns of behaviors, interests and activities" (Dufour-Rainfray et al., 2011, p. 1255). The Diagnostic and Statistical Manual of Mental Disorders, 5th addition (DSM-5) has established the spectrum into two broader categories - Autism Spectrum Disorder and Social Communication Disorders (Sung et al., 2014). The diagnosis of autism is on the rise and although there is no specific etiology known to cause this disorder, it is believed that a combination of both genetic and environmental factors have an impact on the development of this disorder. A healthy prenatal period is necessary for proper fetal development. Foreign environmental challenges can cause modifications in brain development which is presumed to lead to autism (Dufour-Rainfray et al., 2011). Recently, more studies have been connecting environmental factors to the cause of autism. The environment can be categorized as all non-genetic factors, from viruses and medications, to social and cultural influences. Some major environmental toxins that have been studied to link to autism are maternal lifestyle, medical drugs, recreational drugs, alcohol, and pollutants (Lyall, Schmidt, & Hertz-Picciotto, 2014).

Cocaine and Autism

Cocaine is the number one drug of choice among pregnant women in the United States. According to a study by the National Association for Perinatal Addiction Research and Education, (NAPARE) 36 hospitals from around the country showed an overall 11% incidence of substance abuse in pregnancy (as cited by Davis et al., 1992). A study done by Davis et al. (1992) assessed 40 children with cocaine exposure in utero. Prenatal drug exposure was confirmed with a positive toxicology report in the child's medical chart, the mother's admission, or the referring physician's report. A physical examination, neurological screening, and developmental assessment were all evaluated. Significant developmental delays were noted in language, fine motor skills, gross motor skills, social skills, play and 8 (11%) of the children met the criteria for autism (Davis et al., 1992).

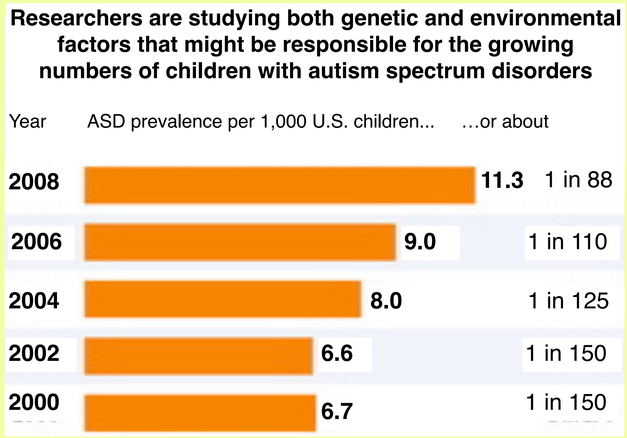

Figure 1. Rising prevalence of autism in the United States (Shirley, 2013).

Pollution and Autism

Air pollution exposure during pregnancy has been reported to have physical and developmental effects on the fetus. As stated by Currie et al. (as cited by Volk, Hertz-Picciotto, Delwiche, Lurmann, & McConnell, 2011), high levels of air pollution have been associated with very low birth weight, preterm birth and infant mortality. Exposure to air pollution and its components, not only in the prenatal period but also in early postnatal life, has been linked to poor developmental outcomes as well (Volk et al.,2011). One study observed the influence of exposures to traffic-related pollution, such as carbon monoxide, nitrogen dioxide, nitrogen monoxide, and ozone, during pregnancy and time of delivery on the development of autism. A land use regression (LUR) model was used to collect data (Becerra, Wilhelm, Olsen, Cockburn, & Ritz, 2013). A LUR model is used to characterize air pollution exposure and health effects for individuals residing within urban areas. The results suggested there was an association between autism and prenatal air pollution exposure which was mostly related to traffic sources (Beccerra et al., 2013). A second study examined the association between autism and proximity of residence to freeways during pregnancy, as a surrogate for air pollution exposure. It was concluded that residency within 309 meters of a freeway at time of delivery, almost doubled the odds of giving birth to a child with autism (Volk et al., 2011).

Alcohol and Autism

A high prenatal alcohol exposure is associated with impaired neurodevelopment in humans so it is possible that prenatal alcohol exposure increases the risk of autism (Eliasen et al., 2010). Alcohol abuse is a public health problem due to its increasing consumption in pregnant women throughout many countries (Dufour-Rainfray et al., 2011). A large study done by Eliasen et al. (2010) studied 80,552 children and their mothers who admitted to using alcohol during pregnancy. Of the 80,552 pregnant women, 401 gave birth to a child diagnosed with autism; therefore, no association was found between alcohol consumption and autism (Eliasen et al., 2014).

Medicine and Autism

•A study done by Dufour-Rainfray et al. (2011) explains the relationship between in-utero exposure to certain drugs and their connection to autism in children. The anti-epileptic drug valproic acid (VPA) has been studied and highly correlated to increase the chances of autism. Because valproic acid causes such profound birth defects, it has been classified as a pregnancy category D medicine by the American Food and Drug Administration. A specific study revealed that 4 out of 57 children (7%) that were exposed to valproic acid had a diagnosis of autism (Moore et al., 2000). Other than autism, valproic acid can cause damages such as facial and organ abnormalities, respiratory, cardiovascular and musculoskeletal system dysfunction and developmental disabilities (Rout & Clausen, 2009).

•Thalidomide, which was used as a sedative in the 1950s, has also been associated to increase the likelihood of autism when introduced in-utero (Rout & Clausen, 2009). The effects of thalidomide were minimal during rodent testing and its malformation in humans was not anticipated. The term "fetal thalidomide syndrome" was introduced to describe the consequences of exposure (Dufour-Rainfray et al., 2011). As stated by Stromland (as cited by Dufour-Rainfray et al., 2011), 4 out of 86 patients with prenatal thalidomide exposure met the criteria for autism. It is believed that thalidomide exposure directly disturbs DNA. Some other results that can occur from thalidomide exposure are congenital and craniofacial malformations (Ward, 2014).

•Misoprostol is a drug used to prevent gastric ulcers and is sometimes used for self-induced abortions. Children born after misoprostol exposure show cranial nerve hypoplasia, sometimes associated with Mobius sequence (Dufour-Rainfray et al., 2011). Moebius sequence is a rare congenital disorder usually defined as a combination of facial weakness and inability to move eyes from side to side (Briegel, Schimek, Kamp-Becker, Hofmann, & Schwab, 2009). According to Bandim (as cited by Dufour-Rainfray et al., 2011), a Brazilian study concluded that 4 out of 14 patients with misoprostol exposure in-utero had autism or showed autistic-like behaviors. Other common symptoms of children prenatally exposed to misoprostol is malformation of limbs, brainstem, spinal cord and intestines (Dufour-Rainfray et al., 2011).

Conclusion

It is clear that there is no single or universal cause of autism; rather, many environmental and genetic factors are likely involved, and the specific subsets of factors that are operating will vary across different individuals (Lyall et al., 2014). Hopefully with further research, scientific conclusions about etiologies of autism will be determined.