Chemicals, Nutrition, and Autism Spectrum Disorder: A Mini-Review

Takeo Fujiwara [1, 2]*, Naho Morisaki [1], Yukiko Honda [1, 3], Makiko Sampei [1] and Yukako Tani [1, 2, 4]

[1] Department of Social Medicine, National Research Institute for Child Health and Development, Okura, Setagaya-ku, Tokyo, Japan, [2] Department of Global Health Promotion, Tokyo Medical and Dental University, Tokyo, Japan, [3] Global Cooperation Institute for Sustainable Cities, Yokohama City University, Yokohama, Japan, [4] Department of Health Education and Health Sociology, School of Public Health, The University of Tokyo, Tokyo, Japan

The rapid increase of the prevalence of autism spectrum disorder (ASD) suggests that exposure to chemicals may impact the development of ASD. Therefore, we reviewed literature on the following chemicals, nutrient to investigate their association with ASD: (1) smoke/tobacco, (2) alcohol, (3) air pollution, (4) pesticides, (5) endocrine-disrupting chemicals, (6) heavy metals, (7) micronutrients, (8) fatty acid, and (9) parental obesity as a proxy of accumulation of specific chemicals or nutritional status. Several chemical exposures such as air pollution (e.g., particular matter 2.5), pesticides, bisphenol A, phthalates, mercury, and nutrition deficiency such as folic acid, vitamin D, or fatty acid may possibly be associated with an increased risk of ASD, whereas other traditional risk factors such as smoking/tobacco, alcohol, or polychlorinated biphenyls are less likely to be associated with ASD. Further research is needed to accumulate evidence on the association between chemical exposure and nutrient deficiencies and ASD in various doses and populations.

Keywords: autism spectrum disorder, air pollution, chemicals, pesticide, fatty acid, micronutrients, heavy metal, environment

INTRODUCTION

Autism spectrum disorder (ASD) is a developmental disorder typified by impaired communication and social skills (Grabrucker, 2012). A recent increase in cases of ASD from 4–5 of 10,000 persons in 1966 to 100 cases of 10,000 persons currently (Fombonne, 2009) may not solely be explained by genetic factors (Abrahams and Geschwind, 2010). Thus, it needs to be determined whether environmental factors play a role in the onset of ASD (Grabrucker, 2012), and a recent study using twin samples reported that around 50% of cases of ASD can be explained by environmental factors (Hallmayer et al., 2011).

In the present mini-review, we report several relatively new studies that have evaluated the association between ASD and environmental factors by focusing on chemical or nutritional exposures because these are modifiable factors. These exposures included smoking/tobacco, alcohol, air pollution, pesticides, endocrine-disrupting chemicals, heavy metals, micronutrients, and fatty acid. Parental obesity was also included as an exposure because maternal obesity can be an indicator of exposure to chemicals or nutrition.

SMOKE OR TOBACCO

Although not consistent, most recent population-based studies have suggested that maternal smoking during pregnancy is not directly associated with ASD after adjusting for socioeconomic status (Burstyn et al., 2010; Kalkbrenner et al., 2012; Lee et al., 2012; Tran et al., 2013). For example,