Environmental Exposure & Autism: The Role of Physician Counseling in Incidence Reduction

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Abstract

Maternal environmental exposures to certain specific chemicals during early pregnancy, including pesticides, air pollutants and others, are known to increase the incidence of autism and autism spectrum disorder in offspring. The prevalence of these diseases can be reduced by taking steps to reduce environmental chemical exposures. Obstetricians and family practice physicians typically counsel patients on good health practices during pregnancy, including proper nutrition, the need for exercise, weight control, avoidance of drugs and other safeguards. It is proposed here that physician counseling of patients include information about the identification and avoidance of exposures to environmental neurotoxins that have been identified as causative agents for autism and autism spectrum disorder and that such counseling will lead to a decrease in the incidence of these diseases.

Introduction

Autism and autism spectrum disorders (ASD) are neurodevelopmental disorders characterized by social interaction, communication and behavioral flexibility deficits for which no single cause has been identified[1]. Although there are published studies suggesting that ASD ensues following preconceptional, gestational and early childhood periods, it is widely accepted that genetic and environmental factors are contributory[2] and that maternal exposures to neurotoxic environmental chemicals during the first trimester of pregnancy (corresponding to the time of neural tube closing) present a particular risk for the onset of these diseases[3]. The prevalence of ASD has increased approximately 10-fold in the past 40 years and continues to grow at an alarming rate world wide. In the United States, it is currently estimated that the overall prevalence for 8-year olds is 1 in 66 overall, 1 in 42 for boys and increasing[4].

It has been well established that environmental exposures to certain specific chemicals and chemical classes increase the incidence of ASD[5]. It is hypothesized here that ASD incidence can be reduced by taking steps to reduce environmental chemical exposures. These are further elaborated on below.

OBGYN and primary care physicians typically counsel patients on good health practices, including proper nutrition, the need for exercise, weight control, and avoidance of alcohol, mercury, caffeine, tobacco use, recreational drug use and the limiting of pharmaceuticals during pregnancy. “It is proposed here that OBGYN and primary care counseling of patients on the identification and avoidance of exposures to environmental neurotoxins that are known to increase the incidences of these diseases can lower the incidences of ASD”. It is the purpose of this report to identify the known toxic environmental chemicals that are causative agents for ASD and to recommend that physicians who care for pregnant women counsel their patients on how to reduce exposures to such chemicals and thereby lower the prevalence of ASD.

Methods

The results presented here are based upon a PubMed based review of the literature from 1990 through 2014 of numerous studies on the toxic effects of the chemicals on the body and mechanisms that have been proposed for the actions of these chemicals in triggering ASD. These studies include epidemiological, case and laboratory studies. Adverse effects on health were in all instances diagnosed via appropriate clinical examinations and testing.

Results

Several environmental factors have been associated with the increase in ASD prevalence. Male as well as female parental age are factors, with the offspring of older mothers or older fathers having a higher risk for developing ASD than those of younger parents[6,7]. Also, ASD are more prevalent when parents are more highly educated and of higher socioeconomic status[8], there is maternal use of cocaine[8] or valproate during pregnancy[9,10], residence in urban areas[11] or in areas of high air pollution, living in proximity to toxic waste sites, and exposures to specific toxic chemicals and chemical classes[12] also increase the
incidence of ASD. These chemicals include persistent organic pollutants (POPs) including polychlorinated biphenyls (PCBs), pesticides; heavy metals; phthalates; bisphenol A (BPA); polynuclear aromatic hydrocarbons (PAHs); and low molecular weight hydrocarbons[13]. These and the references for them are listed in Table 1.

Table 1: Chemicals associated with increased incidence of ASD and the references for these. * denotes lipophilic species.

| Chemical                              | References |
|---------------------------------------|------------|
| Cocaine                               | 22         |
| Thalidomide                           | 22         |
| Valproate                             | 10         |
| Mercury                               | 13,23,26   |
| Nickel                                | 26         |
| Lead                                  | 12,13      |
| Manganese                             | 12         |
| Arsenic                               | 13         |
| Cadmium                               | 26         |
| Fluoride                              | 13         |
| Polyvinyl chloride*                   | 28         |
| Vinyl chloride*                       | 26         |
| Trichloroethylene*                    | 26         |
| PCBs*                                 | 13,15      |
| Organophosphate pesticides            | 13,24      |
| Organochlorine pesticides*           | 12,13,15   |
| Polynuclear aromatic hydrocarbons*    | 13         |
| Brominated diphenyl ether flame retardants* | 13,15 |
| Perfluorinated compounds*            | 13         |
| Dialkyl phosphate*                    | 15         |
| Bisphenol A*                          | 15         |
| Phthalates*                           | 15         |
| Methylene chloride*                   | 23         |
| Toluene*                              | 13,27      |
| Xylene*                               | 27         |
| Lacquer*                              | 27         |
| Varnish*                              | 27         |
| Asphalt*                              | 27         |
| Mixed organic solvents*               | 27         |
| Chemicals from traffic-related air pollution* | 25         |
| Automotive exhaust*                   | 13         |
| Diesel fumes*                         | 23         |
| Chemicals exuded from toxic waste sites* | 13,27     |

Several mechanisms have been proposed for the connection between maternal environmental exposures to toxic chemicals and the increased prevalence of ASD. These include endocrine disruption[14,15], oxidative stress[16], epigenetic effects[17,18] and total serum exogenous chemical lipophilic load[19]. A discussion of these is beyond the scope of this paper. It can be accurately stated, however, that all of the chemicals in table 1 have been shown to be endocrine disruptors, cause oxidative stress and epigenetic effects. To date, no definitive explanation has been arrived at. The results presented here are empirical and based on epidemiological observation. It is hypothesized here that regardless of the mechanism of action, avoidance of exposures to these chemicals will help reduce the incidence of ASD.

The following reported studies support the causative effects of environmental exposures on the increasing prevalence of ASD.
1. Studies in California[20] and Japan[11,21] have shown that urban living results in higher incidences of ASD than rural living. This phenomenon has been ascribed to the higher degree of air pollution in urban areas[22].
2. ASD rates are elevated in a dose-dependent relationship when mothers reside in areas where agricultural pesticides are widely used[23,24].
3. Increased rates of ASD in the offspring of parents who are more highly educated and who bear children at a later age[8]. Such parents tend to live in more urbanized settings where air pollution levels are higher[22].
4. The association of increased ASD rates with increased air pollution has been demonstrated by several studies[13,25-27].
5. A study in Sweden has shown that autism and ASD rates are 35% higher when mothers reside in homes with vinyl flooring, as opposed to wood or carpeted floors[29]. Vinyl floors exude phthalates and vinyl chloride, compounds that have been associated with increases in ASD[15,26].
6. The chemicals listed in table 1 are all neurotoxic species. Neurotoxic chemicals have been shown to cause neurological disease, neurodevelopmental disease (including ASD) and neurodegenerative disease. Accordingly, all neurotoxic chemicals (more than 200 of which have been identified to date) are suspected of being causative agents for ASD[13].
7. A dose-response relationship between total lipophilic load and the onset of neurological disease has been reported[30]. The starred chemicals (*) in table 1 are lipophilic species.
8. The offspring of obese mothers have a higher incidence of ASD than controls[29]. This phenomenon may be accounted for by the following consideration. Obesity leads to increases in endogenous serum lipophiles (cholesterol and triglycerides), which serve as absorption enhancers for exogenous neurotoxic lipophilic species (PCBs, organochlorine pesticides, bisphenol A, phthalates, polynuclear aromatic hydrocarbons and low molecular weight hydrocarbons, as well as other lipophilic species)[30]. Accordingly, obesity is associated with higher body loads of exogenous lipophilic compounds identified as causative agents for ASD as well as with elevated total lipophilic loads associated with increased neurological disease[31].

Discussion

The concept of maternal exposures to exogenous toxic environmental chemicals as a factor in the ever increasing incidence of ASD is supported by the results presented above. It is, therefore, to be expected that other lipophilic species, in addition to those listed in table 1 may be causative agents for ASD. Such species include mycotoxins from mold, food preservatives such as butylated hydroxy toluene (BHT) and butylated hydroxy aniline (BHA), disinfectants used in personal care and cosmetic products such as triclosan and parabens[3].

Based on these considerations, it is clear that the potential exists to reduce the incidence of ASD by limiting exposure to the chemicals discussed. A large reduction in exposure to ASD-causing environmental chemicals can be accomplished.
via physician counseling of their pregnant patients.

The recommendations below for counseling of patients are presented in this vein. None of the recommendations given are deemed to be harmful to either the mother or the fetus, therefore no risk is envisioned for their implementation. Since all of the chemicals listed have been shown to trigger other environmental diseases and co-morbidities[33], adherence to these recommendations can help reduce cardiovascular, metabolic and other neurological diseases[3,31,32].

The following 11 recommendations for counseling of pregnant women about the potential to lower autism prevalence are offered. It is recognized that complete avoidance of exposures to ASD causing chemicals is essentially impossible. The body does, however, metabolize and/or eliminate these toxins and so it is possible for it to cleanse itself if exposures are kept to a minimum[3].

1. Adherence to a Mediterranean type diet. Diabetes[34], cardiovascular disease[35], Alzheimer’s and other neurological diseases[36,37] and cancer[38] rates have been shown to be lower in people who do so. Such a diet will greatly limit exposure to persistent organic pollutants such as PCBs and organochlorine pesticides, as well as to phthalates and other toxic lipophilic chemicals. ASD prevalence and its relationship to a Mediterranean diet is yet to reported on. Based on the preventive effect of such a diet on other environmental diseases, however, there is every reason to believe that such a diet will have a reductive effect on the prevalence of ASD.

2. Avoiding eating processed foods. These contain numerous neurotoxic chemicals including some associated with increased ASD prevalence[39].

3. Avoiding air pollution to the extent possible. Polluted air contains polynuclear aromatic hydrocarbons, low molecular weight hydrocarbons and other toxins. Limit exposure on heavily polluted days to reduce inhalation of airborne pollutants[40].

4. Drinking bottled water or carbon filtered water. Municipal water supplies often contain large numbers of neurotoxic chemicals, including disinfection by-products such as chloroform[42].

5. Using glass and metal dishes, drinking cups, utensils and food storage containers. Plastics with recycle numbers 3, 6 and 7 may contain phthalates, styrene monomer and BPA, respectively. Encouraging the use of plastic ware that bears the label “phthalate and BPA free”[22].

6. Not only should one not smoke, but second hand smoke and exposure to tertiary smoke (that released from clothing and fur) should also be avoided. Exposure to second hand and tertiary smoke results in the inhalation of the same chemicals that are inhaled from smoking[22].

7. Avoiding the application of pesticides and herbicides when gardening and not walking barefoot on lawns that have been treated with these chemicals[22].

8. Avoidance of using or being in the area where, paints, adhesives, varnishes, stains and other chemicals that have “flammable” or “combustible” warnings on their labels. These materials emit toxic hydrocarbons upon drying[22].

9. Limiting the use of cosmetics, scents, deodorants, hair sprays and other personal care products to the extent possible. These contain phthalates and other neurotoxins[22].

10. If advised to lose weight, doing so slowly. White adipose tissue (WAT) acts as a reservoir for POPs and rapid reduction of WAT results in the release of retained POPs into the bloodstream. Since the body metabolizes and eliminates these compounds slowly, it is preferable to not over-elevate serum levels with these ASD causative chemicals[39].

11. Avoidance of damp buildings. These contain of mold and mildew which produce mycotoxins, known neurotoxic chemicals[40].

Following these guidelines not only should have a significant impact on lowering ASD, it would also serve to lower the potentials for other environmental diseases. All of the chemicals identified above as potential causative agents for ASD are known to cause type 2 diabetes, cardiovascular disease, other neurological disorders, respiratory disease, immunological effects, obesity, musculoskeletal disease, deleterious endocrine effects, birth defects and cancer.

Conclusions

The rapid spread in the global prevalence of ASD mirrors the exponential growth in the use of toxic chemicals in the past two generations. No single causative agent or mechanism of action can account for this rapid growth. The data collected, however, strongly suggest that multiple chemicals are responsible for this pandemic and support the hypothesis that ASD prevalence can be reduced if pregnant women limit their exposures to heavy metals and lipophilic organic compounds. OBGN and primary care physician routine counseling of patients on steps to be taken to limit exposures to ASD inducing toxic chemicals can dramatically lower the prevalence of ASD.

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