# Connections Between Prenatal Exposure to *Household Toxic Chemicals and Autism?*

*by Abbie Goldbas, MS Ed JD*

***Abstract: This report examines the possibility that autism may be related to toxic chemicals in commonly used household products. Certain environmental chemicals are known to cause neurological damage to fetuses; however we do not know their connection, if any, to autism. This discussion includes (a) autism; (b) fetal vulnerability; (c) toxic chemicals' link to birth defects; (d) possible links between chemicals and autism; (e) necessity for governmental regulations for household chemicals; and (f) the need for research regarding a potential relationship between toxic household chemicals and autism.***

*Keywords: toxic, household products, environment, autism, teratogens, epidemic*

## Could There Be Connections Between Prenatal Exposure to Household Toxic Chemicals and Autism?

Autism is a neurological, developmental disorder. The first symptoms become apparent in early childhood and often last a lifetime. In most cases, by the age of three the autistic child will demonstrate three core symptoms of behavioral, cognitive, and affective irregularities: (a) reduced ability to interpret emotions and intentions of others; (b) reduced capacity for social interaction and communication; and (c) preoccupation with a single subject or activity (Baron-Cohen & Belmonte, 2005). These symptoms affect every aspect of being. While many autistic children develop severe, disabling symptoms, including cognitive deficits for which they require special education programs and full-time care, many are not as debilitated. Because the symptoms are so varied, with some children considered "high functioning," the disorder is also referred to as autism spectrum disorder (ASD) (Warner, 2011). The caretakers' lives are often disrupted as well. Additionally, autism affects far more than the individual and their family: the medical profession, the educational system, and adult care programs – the entire socioeconomic structures of our society have felt the impact of this widespread disorder. The prevalence of autism is a major concern because millions of dollars are spent on them throughout our health care and educational systems (Knapp, Romeo, & Beecham, 2009).

Health care professionals must have an understanding and teach their clients about potential harms to unborn babies. An important consideration today is the possibility that some of the chemicals we frequently use to clean our homes or in our personal hygiene routines may be toxic. Are these safe for the fetus?

Autism is now an epidemic in the United States. In the past decade the incidence of autism has skyrocketed from one in 1,000 children to 9.1 in 1,000 children. Boys make up 80% of autistic children and 50% of all are alleged to be mentally retarded (Centers for Disease Control and Prevention, 2006). Landrigan, Kimmel, Correa, and Eskenazi (2004) have noted that generally, neurodevelopmental disorders such as autism affect 5-10% of the four million babies born each year in the U.S. Further, from 1991 to 2001, the rate of children who were diagnosed with autism in the United States rose by approximately 1,700%.

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The etiology of autism is unknown. We do not know what causes this neurodevelopmental disorder. Immunological, genetic abnormalities, infections, and metabolic factors are all likely contributors (Stoltenberg et al., 2010). The recent increase in the numbers of autistic children may be due to today's sophisticated diagnostic procedures, though these are considered to account for only about 25% of the recent numbers (King & Bearman, 2009). There is increasing evidence that fetal exposure to toxic environmental chemicals may be one of the many contributing factors in the development of autism. Further evidence is being gathered in the burgeoning medical field known as developmental neurotoxicology. This field of study examines the effects of early chemical exposures on the developing brain (Stein, Schettler, Wallinga, & Valenti, 2002). Neurotoxicologists have not yet begun in earnest to examine common household products for toxic chemicals as they relate to autism.

## History

Autism was originally identified by Kanner (1943). He named the syndrome autism (auto meaning self; ism meaning condition) because he saw that his autistic patients acted in a self-absorbed manner. Kanner understood autism to be biological. He observed that the children were intelligent and the parents often had unusual characteristics similar to their children's. He thus determined that autism was to some extent inherited.

Today, it is speculated that genetics may be linked to about 35-40% of autism; autism is therefore moderately inheritable (Stilp, Gernsbacher, Schweigert, Arneson, & Goldsmith, 2010). As stated above, there are numerous other factors which can combine to increase the chance of a child developing autism. Eventually, a single cause may be found, however more likely, there may be a combination of factors, i.e., gene-environment interactions, as stated above (Stoltenberg et al., 2010). Gluten (GLU), dietary proteins, and peptides have been proposed as possible causes (Vojdani, Pangborn, Vojdani, & Cooper, 2003). Childhood Autism Risks from Genetics and the Environment (CHARGE, 2011) is a large, epidemiological study of thousands of children in California. It has found that a family's proximity to the freeway may be associated with autism. The renowned British autism specialist, Simon Baron-Cohen, has recently suggested that parents with similar careers are somewhat more likely than the general public to have autistic offspring (Warner, 2011). Croen, Grether, Yoshida, Odouli, and Hendrick (2011) recently studied records of mothers who were medicated with antidepressant drugs during pregnancy. They found that there may be a limited increased risk of ASD in mothers who used selective serotonin reuptake inhibitors during the year before delivery. They determined the greatest risk for an autistic child was if the antidepressants were taken in the first trimester of pregnancy. For many years there was a widespread scare that exposure to prenatal and infant vaccines with thimerosal, a mercury-containing preservative, was linked to autism. This has been determined to be untrue. The Centers for Disease Control and Prevention (2010), through their Vaccine Safety Datalink Project (VSD), have conclusively stated that exposure to thimerosal-containing immunizations is not associated with any ASD outcomes. Diverse hypotheses are not new; what is new is the suspicion that household chemicals may be a risk.

## Fetal exposure to toxic chemicals

Since the 1970's, we have known about the dangers of many environmental chemicals to children and fetuses. For instance, for many years we have taken steps to eliminate lead in our environment because lead causes neurological damage, especially to children who ate lead in peeling paint chips or inhaled in fine dust particles (CDC, 1997). Likewise, we now know that neurological damage is related to pesticides, mercury, and arsenic exposure (Goldman & Koduru, 2000).

Health care professionals are concerned with two issues: (a) the critical developmental periods of a child; and (b) environmental risk factors. First, Arndt, Stodgell, and Rodier (2005) have determined that the primary focus of current research should be on the prenatal period. It has long been clear that prenatal exposure to toxins such as pesticides can be a risk for neurological damage, as stated above. This is

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because fetuses are particularly vulnerable to toxins due to their inability to metabolize, detoxify, and excrete toxic agents. Fetuses and children experience rapid growth and complex brain development which can be easily disrupted (Rodier, 1995).

Secondly, toxic chemicals may *indirectly* cause neurological damage to the fetal brain leading to autism. Chemicals which are perhaps linked to autism are already known to be neurological toxins generally: lead, mercury, pesticides, and certain medications (Stein, Schettler, Wallinga, & Valenti, 2002). Now, toxic chemicals in household products are suspected to trigger autism because (a) their use has increased dramatically over the past few decades along with the incidence of autism, and (b) they are known to disrupt neural development. Two common examples are: (a) Polybrominated diphenylethers (PBDEs) are brominated flame retardants often found in babies' pajamas, sofas, and carpet fabrics. These chemicals bind to the thyroid and alter fetal development; and (b) Polychlorinated biphenyl (PCBs), known to be hormone disruptors. They still linger in human beings and the food chain even though they were banned several decades ago. They were banned due to their toxicity causing brain abnormalities similar to the autistic brain (Messer, 2010).

## Recent Research

CHARGE (Childhood Autism Risks from Genetics and Environment) began in 2002 and is still ongoing. This is the only major study which attempts to understand whether there is a relationship between household chemical use and autistic spectrum disorder. Other recent studies either involve the same chemicals that we have known for years to be toxic, or they do not pertain to autism. The CHARGE study was launched by a group of scientists at the University of California-Davis Center for Children's Environmental Health (Hertz-Picciotto et al., 2006). Its purpose is to study the genetic and environmental influences causing autism and developmental delays because there is so little information regarding the etiology of these disabling conditions. CHARGE is a large, case-control, epidemiologic investigation. Approximately 1,500 to 2,000 children and their parents are participating. Extensive personal histories are gathered, physical and psychological tests given, and participants' blood samples for chemical exposure are taken. Researchers are working in coordination with other organizations across the country.

The most recent information germane to this discussion to come out of the CHARGE study was published in 2011. Hertz-Picciotto, et al. (2011) extracted blood serum at certain intervals from 100 children from the larger study group to determine the relationship between autism and PBDE (flame retardant found in pajamas, see above). It was concluded that there was no statistically significant association between ASD and PBDE. The limitations of the study included (a) no blood serum tests were conducted to determine PBDE content pre-ASD diagnosis, and (b) several confounding factors which compromised the data should have been eliminated. Additionally, at the UC Davis Health System which is affiliated with CHARGE, it was found that those women who did not take vitamins before and at least during the first month of pregnancy were twice as likely to have an autistic child (UC Davis Health System, 2011).

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It is not unusual for scientists to follow rather than lead trends because of the time it takes to conduct dependable research. Nevertheless, some who are less patient are observing our rampant and perhaps unreasonable use of household chemicals about which we know very little. There is a grassroots movement in our country to return to the consumption of whole, non-processed foods and products which are natural and chemical-free.

Today, the pollution in our homes is four to five times higher than the outdoors (Marty, 2007). This is because of the chemicals we use in our carpets and cleaning and personal hygiene products. Some urge us to discontinue their use because it is known that many of these same chemicals are implicated in cancer etiology and birth defects (van den

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Hazel et al., 2006). We are further advised to use natural products because there is a "common sense" notion that the drastic increase in autism over these past 20 years may somehow be related to the alarming increase in the toxic chemicals we use in our homes.

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## Examples of Known Toxic Chemicals in Cleaning and Personal Hygiene Products

We describe four of the many chemicals which are commonly used in our homes and which are already known toxins. This information is based upon The United Nations Globally Harmonized System of Classification and Labeling of Chemicals (UNGHS) and the International Agency for Research on Cancer (IARC) which is part of the World Health Organization. The Consumer Product Safety Commission and the Environmental Protection Agency use similar definitions. Note that the US Food and Drug Administration (FDA) has not categorized the toxicity levels of cosmetics which contain toxic elements (Hollender, 2010).

**PEGs** – PEGs, also known as ethoxylates and polyethylene glycol (those with "eth" in the ingredient names), are found in cosmetics, shampoos, and hand soaps to create foam and help water mix with oils. These are known reproductive toxins and may be linked to birth defects. Because they are listed as "cosmetics", the US FDA does not define their level of toxicity (Hollender, 2010).

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**Parabens** (butyl-, propyl-, ethyl-, and methyl-) – These are known as re-nostrogens which means they interfere with the body's hormone estrogen. Parabens are synthetic preservatives and disinfectants. They are used in products such as deodorants, antibacterial ointments, shampoos, and sunscreens. Parabens are not only hormone disrupters but also reproductive/developmental toxins. Parabens, like PEGs, are categorized as cosmetics and therefore have no given level of toxicity (Hollender, 2010). Jacobson and Jacobson (1996) state that endocrine disruptors are environmental hazards for neurodevelopment.

**Phthalates** – These are used to improve plasticity in plastic containers and as solvents for fragrances. They are known reproductive toxins and may cause birth defects (March of Dimes, 2011). Phthalates are found in synthetic perfumes and fragrances – anything that has "fragrance" in the ingredient's label, including air fresheners, liquid soaps, and laundry detergents. They are also found in carpets and foam furniture (new carpeting has 120-odd chemicals) (Marty, 2011).

Vinyl floors contain phthalates. Larsson, Weiss, Janson, Sundell, and Bornehag (2009) were researching developmental disorders and asthma and accidentally found a relationship with vinyl floors and autism. In 2000, they interviewed parents of 4,779 children between the ages of 1-6 years who all resided in the same county in Sweden. The questions included, *inter alia*, those about income, medical history of all family members, and mother's cigarette smoking. In 2005, a second questionnaire was completed by the same parents. In addition to the general questions above, they were asked if any of their children between 2000 and 2005 were professionally diagnosed as having autism. They found that 72 children had been diagnosed with autism, 60 boys and 12 girls. The results of the study show five statistically significant variables which indicated autism: maternal smoking, male sex, problems in the home with poor ventilation (condensation on windows), financial problems/low socioeconomic level, and PVC flooring, especially in the parents' bedroom. During the second phase of the study, it was established that the vinyl flooring was the source of the indoor phthalates.

**Dioxins** – These are the most potent carcinogens known to science (Marty, 2007). Dioxins cause birth defects, immune system damage and cancer. Dioxins are found

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in commonly used laundry detergents, liquid soaps, and window cleaners (Snow, 2009). After extensive research, nothing was found which stated dioxins were not toxic. The World Health Organization (2011) considers dioxins to be highly toxic and able to cause reproductive and developmental problems, damage the immune system, interfere with hormones, and cause cancer.

## Conclusion and Future Research

There are numerous books available for those who seek non-toxic products or are at least interested in gaining a greater understanding of the chemicals we use. We have cited Planet Home by Jeffrey Hollender (2010). He is the co-founder of the Seventh Generation line of natural products. It is an old and well-respected company which makes popular natural products that can be found in many supermarkets. This book and others give practical advice for children and adults, including tips on using baking soda and vinegar instead of ordinary products. Additionally, a great deal of information can be found on the Internet.

The increasing incidence of autism over the past decade has coincided with the prevalence of childhood asthma and metabolic syndrome, especially in the United States and United Kingdom. It is suggested that future research into the relationships among these disorders may lead to epidemic patterns and clues, and ultimately to more effective safety standards for the chemicals we use (Curtin, Anderson, Must, & Bandini, 2010).

Stein, Scheduler, Walling, and Valentine (2002) perceive the possible relationship between the toxic household chemicals and childhood neurological disorders. They propose that citizens and health care workers encourage policymakers and health officials to research toxic chemicals and also create effective safety legislation for the industry, at least for the unborn. This is because out of approximately 80,000 chemicals which are currently in commercial use, only 12 or so have been sufficiently tested pursuant to the standards promulgated by the Environmental Protection Agency (EPA) for toxicity to the developing brain or nervous system (Makris, Raffaele, Sette, & Seed, 1998). There are 2000 to 3000 chemicals registered each year (US EPA, 1998). Stein et al. (2002) endorse government regulation because, as they note, formal research studies take years and their results often come after the fact.

Focus needs to be maintained on the ASD epidemic and we must stay knowledgeable about the teratogenic effects of toxins in the environment. Specifically, childbirth educators need to stay informed so they can disseminate the precautions. Share new knowledge with pregnant families in classes and/or by the use of informative brochures and videos. Whatever evidence can be gleaned about the relationship between fetal vulnerability to chemicals and developmental disorders is helpful to reduce exposure. Finally, we all have a responsibility to lobby for greater governmental testing and standards to control of the use of toxic chemicals used in homes.

## References

Arndt, T. L., Stodgell, C. J., & Rodier, P. M. (2004). The teratology of autism. *International Journal of Developmental Neuroscience, 23*, 189-199. doi: 10.1016/j.ijdevneu.2004.11.001.

Baron-Cohen, S., & Belmonte, M. K. (2005). Autism. A window onto the development of the social and the analytic brain. *Annual Review of Neuroscience, 28*(July, 2005), 109-126. doi: 10.1146.annnurev.neuro.27.07020344137.

Centers for Disease Control and Prevention. (2010). Vaccine safety. Retrieved February 6, 2012, from http://www.cdc.gov/vaccinesafety/Concerns

Centers for Disease Control and Prevention. (2006). Autism and Developmental Disabilities Monitoring Network surveillance year 2006. Principal Investigators. *Prevalence of autism spectrum disorders – Autism and Developmental Disabilities Monitoring Network, United States, 58*(10), 1-20.

Centers for Disease Control and Prevention. (1997). Update: Blood Lead Levels – United States, 1991-1994. *MMWR Morbidity and Mortality Weekly Report, 46*(7), 141-146.

Childhood Autism Risks from Genetics and the Environment (CHARGE). (2011). *Update March 2011*. Retrieved February 14, 2012, from http://beincharge.ucdavis.edu/newsupdates.html

Croen, L. A., Grether, J. K., Yoshida, C. K., Odouli, R., & Hendrick, V. (2011). Antidepressant use during pregnancy and childhood autism spectrum disorders. *Archives of General Psychiatry, 68*(11), 1104-1112. doi: 10.1001/archgenpsychiatry.2011.73.

Curtin, C., Anderson, S. E., Must, A., & Bandini, L. (2010). The prevalence of obesity in children with autism: A secondary data analysis using nationally representative data from the National Survey of Children's Health. *BMC Pediatrics, 10*. doi: 10.1186/1471-2431-10-11.

Goldman, L. R., & Koduru, S. (2000). Chemicals in the environment and developmental toxicity to children: A public health and policy perspective. *Environmental Health Perspective, 108*(suppl. 3), 443-448.

Hertz-Picciotto, I., Bergman, A., Fangstrom, B., Rose, M., Krakowiak, P., Pessah, I., Hansen, R., & Bennett, D. H. (2011). Polybrominated diphenyl ethers in relation to autism and developmental delay: A case-control study. *Environmental Health Perspectives, 10*, 1-11. doi: 10.1186/1476-069X-10-1.

Hertz-Picciotto, I., Croen, L. A., Hansen, R., Jones, C. R., van de Water, J., & Pessah, I. N. (2006). The CHARGE study: An epidemiologic investigation of genetic and environmental factors contributing to autism. *Environmental Health Perspectives, 114*(7), 1119-1125. doi: 10.1289/ehp.8483.

Hollender, J. (2010). *Planet Home*. New York City, NY: Clarkson Potter/Publishers.

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Jacobson, J. L., & Jacobson, S. W. (1996). Intellectual impairment in children exposed to polychlorinated biphenyls in utero. *The New England Journal of Medicine, 335*, 783-789.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2*, 217-250.

King, M., & Bearman, P. (2009). Diagnostic change and the increased prevalence of autism. *International Journal of Epidemiology, 38*(5), 1224-1234.

Knapp, M., Romeo, R., Beecham, J. (2009). Economic cost of autism in the United Kingdom. *Autism, 13*(3), 317-336. doi: 10.1177/1362361309104246.

Landrigan, P. J., Kimmel, C. A., Correa, A., Eskenazi, B. (2004). Children's health and the environment: Public health issues and challenges for risk assessment. *Environmental Health Perspectives, 112*(2), 257-265.

Larsson, M., Weiss, B., Janson, S., Sundell, J., & Bornehag, C-G. (2009). Associations between indoor environmental factors and parental-reported autistic spectrum disorders in children 6-8 years of age. *NeuroToxicology, 30*(5), 822-831. doi:10.1016/j.neuro.2002.01.011.

Makris, S., Raffaele, K., Sette, W., & Seed, J. (1998). *A retrospective analysis of twelve developmental neurotoxicity studies.* Submitted to the US EPA Office of Prevention, Pesticides, and Toxic Substances (OPPTS), draft. Retrieved February 14, 2012, from http://www.epa.gov/scipoly/sap/meetings/1998/december/neuro.pdf

March of Dimes. (2011). *Environmental Risks and pregnancy.* Retrieved February 14, 2012, from http://www.marchofdimes.com/pregnancy/staying-safe_indepth.html

Marty, D. M. (2007, February). Carpet highs and whoas. *E Magazine.com*. Retrieved February 14, 2012, from http://www.thefreelibrary.com/Carpet+highs+and+whoas%3A+are+you+walking+on+120+chemicals%3F-a0165577801

Messer, A. (2010). Mini-review: Polybrominated dipenyl ether (PBDE) flame retardants as potential autism risk factors. *Physiology & Behavior, 100*(3), 245-249. doi. 10.1016/j.physbeh.2010.01.011.

Rodier, P. M. (1995). Developing brain as a target of toxicity. *Environmental Health Perspectives, 103* (suppl.6), S73-S76.

Snow, S. (2009). *Fresh Living.* New York City, NY: Bantam Dell.

Stein, J., Schettler, T., Wallinga, D., & Valenti, M. (2002). In harms' way: Toxic threats to child development. *Developmental and Behavioral Pediatrics, 23*(1S), S13-S22.

Stilp, R. L., Gernsbacher, M. A., Schweigert, E. K., Arneson, C. L., & Goldsmith, H. H. (2010). Genetic variance for autism screening items in an unselected sample of toddler-age twins. *Journal of the American Academy of Child Adolescent Psychiatry, 49*(3), 267-276. doi: 10.1016./j.jaac.2009.11.012.

Stoltenberg, C., Schjolberg, S., Bresnahan, M., Hornig, M., Hirtz, D., Dahl, C., Lie, K. K., Reichborn-Kjennerud, T., Schreuder, P. Alsaker, E., Oyen, A-S., Magnus, P., Susser, E., Lipkin, W. I., & the ABC Study Group. (2010). The Autism Birth Cohort: A paradigm for gene-environment-timing research. *Molecular Psychiatry, 15*, 676-680. doi: 10.1038/mp.2009.143.

UC Davis Health System. (2011). Women who start prenatal vitamins early are less likely to have children with autism. Retrieved February 23, 2012, from http://www.ucdmc.ucdavis.edu/newsroom

US EPA. (1998). *Office of Prevention, Pesticides and Toxic Substances: Endocrine Disruptor Screening and Testing Advisory Committee*. Final Report. Washington, DC: US Environmental Protection Agency.

Van den Hazel, P., Zuurbier, M., Babishch, W., Bartonova, A., Bistrup, M. L., Bolte, G. …Koppe, J. G. (2006). Today's epidemics in children: Possible relations to environmental pollution and suggested preventive measures. *Acta Paediatrica, 95*(Supp l453), 18-25. doi: 10.1080/08035320600885846.

Vojdani, A., Pangborn, J. B., Vojdani, E., & Cooper, E. L. (2003). Infections, toxic chemicals and dietary peptides binding to lymphocyte receptors and tissue enzymes are major instigators of autoimmunity in autism. *International Journal of Immunopathology and Pharmacology, 16*(3), 189-199.

Warner, J. (2011, August). Autism's lone wolf: Simon Baron-Cohen wants to know, are 'autistic' traits a predictable outcome of new marriage patterns? *Time Magazine, 78*(8), pp. 44-47.

World Health Organization. (2010). *Dioxins and Their Effects on Human Health*. Retrieved February 20, 2012, from http://www.who.int/mediacentre/factsheets/fs225

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