

# Questions about Prenatal Ultrasound and the Alarming Increase in Autism

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In May 2006, figures from the Centers for Disease Control (CDC) confirmed what too many parents and educators already knew: The incidence of autism is high, making it an "urgent public health issue," according to Dr. José Cordero, director of the CDC's National Center on Birth Defects and Developmental Disabilities. Only 12 years ago autism spectrum disorder (ASD) was so rare that it occurred in just one in 10,000 births.(1) Today ASD, which is characterized by a range of learning and social impairments, now occurs in one in 166 children (2)—with no sign of leveling off.

The steep increase in autism goes beyond the US: It is a global phenomenon, occurring in industrialized nations around the world. In the UK, teachers report one in 86 primary school children has special needs related to ASD.(3)

The cause of autism has been pinned on everything from "emotionally remote" mothers (since discredited) to vaccines, genetics, immunological disorders, environmental toxins and maternal infections. Today most researchers theorize that autism is caused by a complex interplay of genetics and environmental triggers. A far simpler possibility worthy of investigation is the pervasive use of prenatal ultrasound, which can cause potentially dangerous thermal effects.

Health practitioners involved in prenatal care have reason to be concerned about the use of ultrasound. Although proponents point out that ultrasound has been used in obstetrics for 50 years and early studies indicated it was safe for both mother and child, enough research has implicated it in neurodevelopmental disorders to warrant serious attention.

At a 1982 World Health Organization (WHO) meeting sponsored by the International Radiation Protection Association (IRPA) and other organizations, an international group of experts reported that "[t]here are several frequently quoted studies that claim to show that exposure to ultrasound in utero does not cause any significant abnormalities in the offspring. ... However, these studies can be criticized on several grounds, including the lack of a control population and/or inadequate sample size, and exposure after the period of major organogenesis; this invalidates their conclusions...."(4) Early studies showed that subtle effects of neurological damage linked to ultrasound were implicated by an increased incidence in left-handedness in boys (a marker for brain problems when not hereditary) and speech delays.(5) Then in August 2006, Pasko Rakic, chair of Yale School of Medicine's Department of Neurobiology, announced the results of a study in which pregnant mice underwent various durations of ultrasound.(6) The brains of the offspring showed damage consistent with that found in the brains of people with autism. The research, funded by the National Institute of Neurological Disorders and Stroke, also implicated ultrasound in neurodevelopmental problems in children, such as dyslexia, epilepsy, mental retardation and schizophrenia, and showed that damage to brain cells increased with longer exposures.(7)

Dr. Rakic's study, which expanded on prior research with similar results in 2004 (8), is just one of many animal experiments and human studies conducted over the years indicating that prenatal ultrasound can be harmful to babies. While some questions remain unanswered, based on available information, health practitioners must seriously consider the possible consequences of both routine and diagnostic use of ultrasound, as well as electronic fetal heart monitors, which may be neither non-invasive nor safe. *If pregnant women knew all the facts, would they choose to expose their unborn children to a technology that—despite its increasingly entrenched position in modern obstetrics—has little or no proven benefit?*

### **Problems with Sound and Heat**

One challenge that ultrasound operators face is keeping the transducer positioned over the part of the fetus the operator is trying to visualize. When fetuses move away from the stream of high-frequency sound waves, they may be feeling vibrations, heat or both. As the FDA warned in 2004, "ultrasound is a form of energy, and even at low levels, laboratory studies have shown it can produce physical effect in tissue, such as jarring vibrations and a rise in temperature." (9) This is consistent with research conducted in 2001 in which an ultrasound transducer aimed directly at a miniature hydrophone placed in a woman's uterus recorded sound "as loud as a subway train coming into the station." (10)

A rise in temperature of fetal tissue—especially since the expectant mother cannot even feel it—might not seem alarming, but temperature increases can cause significant damage to a developing fetus's central nervous system, according to research. (11) Across mammalian species, elevated maternal or fetal body temperatures have been shown to result in birth defects in offspring. (12) An extensive review of literature on maternal hyperthermia in a range of mammals found that "central nervous system (CNS) defects appear to be the most common consequence of hyperthermia in all species, and cell death or delay in proliferation of neuroblasts [embryonic cells that develop into nerve cells] is believed to be one major explanation for these effects." (13)

*Why should neurodevelopmental defects in rats or other mammals be of concern to expecting women?* Because, as Cornell University researchers proved in 2001, brain development proceeds in the same manner "across many mammalian species, including human infants." (14) The team found "95 neural developmental milestones" that helped them pinpoint the sequence of brain growth events in different species. (15) Therefore, if repeated experiments show that elevated heat caused by ultrasound damages fetal brains in rats and other mammals, one can logically assume that it can harm human brains, too.

In fact, the FDA and professional medical associations know that prenatal ultrasound can be dangerous to humans, which is why they have consistently warned against the non-medical or "keepsake" ultrasound portrait studios that have cropped up in malls throughout the country. (16)

The risks to the baby are potentially higher in commercial enterprises due to the higher acoustic output required for high-definition images, a potentially long session—as technicians hunt for suitable images—and the employment of ultrasound operators who may have no medical background or appropriate training. These variables, along with factors such as cavitation (a bubbling effect caused by ultrasound that can damage cells) and on-screen safety indicators that may be inaccurate by a factor ranging from 2–6 (17), make the impact of ultrasound uncertain even in expert hands. Quite simply, if ultrasound can injure babies, it can cause the same damage whether done for routine, diagnostic or "entertainment" purposes.

### **Elevated Maternal Temperatures Cause Birth Defects**

Understanding what happens when the fetus's temperature increases, whether caused by an elevation in maternal core temperature or by the more local effect of ultrasound, is the key to appreciating prenatal ultrasound risks. An individual's body temperature varies throughout the day due to various factors such as circadian rhythms, hormone fluctuations and physical exertion. While people may have up to 1.5° F in each direction of what is considered a "normal" core temperature, the overall average among people is 98.6° F. An increase of only 1.4° F to 100° F can cause headaches, body aches and fatigue, enough to get the individual excused from work. A temperature of 107° F can cause brain damage or death.

A core temperature of about 98.6° F is important because that is the point at which many important enzyme reactions occur. Temperature affects the actual shape of the proteins that create enzymes, and improperly shaped proteins are unable to do their jobs correctly. As factors such as the amount of heat or duration of exposure increase, enzyme reactions become less efficient until they are permanently inactivated, unable to function correctly even if the temperature returns to normal.(18)

Because temperature is critical to proper enzyme reactions, the body has built-in methods to regulate its core temperature. For instance, when it is too low, shivering warms it up; when it is too high, sweating wicks off the heat. For obvious reasons, fetuses cannot cool off by sweating. However, they have another defense against temperature increases: Each cell contains something called heat shock (HS) proteins that temporarily stop the formation of enzymes when temperatures reach dangerously high levels.(19)

Complicating the issue is the fact that ultrasound heats bone at a different rate than muscle, soft tissue or amniotic fluid.(20) Further, as bones calcify, they absorb and retain more heat. During the third trimester, the baby's skull can heat up 50 times faster than its surrounding tissue (21), subjecting parts of the brain that are close to the skull to secondary heat that can continue after the ultrasound exam has concluded.

Elevated temperatures that might only temporarily affect the mother can have devastating effects on a developing embryo. A 1998 article in the medical journal *Cell Stress & Chaperones* reported that "the HS response is inducible in early embryonic life but it fails to protect embryos against damage at certain stages of development." The authors noted, "With activation of the HS response, normal protein synthesis is suspended...but survival is achieved at the expense of normal development."(22)

### **Autism, Genetics and Twin Studies**

*What does elevated body temperature have to do with autism?* Geneticists are trying to crack the DNA mysteries behind ASD. Recently researchers linked two mutations of the same X chromosome gene to autism in two unrelated families, although they do not yet understand at what stage these genes were damaged.(23) Because sibling and twin studies show a higher prevalence of autism among children in families with one autistic child, geneticists expected to find inherited factors, but despite millions of dollars invested in the search, no clear explanation indicates that ASD is inherited. Perhaps scientists need look no further than at the thermal effects of ultrasound for many answers.

If prenatal ultrasound is responsible for some cases of autism, it stands to reason that if one twin were autistic, the other would have a high probability of being affected, since both would have been exposed to ultrasound at the same time. In both identical and fraternal twins, one twin could be more severely affected than the other if he or she happened to take the brunt of the heat or sound waves. In the case of fraternal twins, since autism strikes males between three to five times more often than females, the sex of the twins also could make a difference in outcome.

A 2002 study showed that simply being a twin substantially increased the likelihood of autism, making twinning a risk factor.(24) *Could this increased twin risk factor have to do with the practice of giving mothers with multiple gestations more ultrasounds than those expecting single births?* While not discounting the role genetics may play in autism, the possible impact of prenatal ultrasound deserves serious consideration.

### **Ultrasound Warnings Unheeded**

The idea that a prenatal ultrasound can be hazardous is not new. The previously mentioned 1982 WHO report, in its summary "Effects of Ultrasound on Biological Systems," stated that "... animal studies suggest that neurological, behavioral, developmental, immunological, haematological changes and reduced fetal weight can result from exposure to ultrasound."(25)

Two years later, when the National Institutes of Health (NIH) held a conference assessing ultrasound risks, it reported that when birth defects occurred, the acoustic output was usually high enough to cause considerable heat.(26). Although the NIH has since stated that the report "is no longer viewed...as guidance for current medical practice," the facts remain unchanged.

Despite the findings of these two major scientific gatherings, in 1993 the FDA approved an eight-fold increase in the potential acoustical output of ultrasound equipment (27), greatly increasing the possibility of disastrous pregnancy outcomes caused by overheating. *Can the fact that this increase in potential thermal effects happened during the same period of time the incidence of autism increased nearly 60-fold be merely coincidental?*

### **Hot Tubs, Steam Rooms, Saunas and Maternal Fevers**

*If the culprit is heat, then what about other situations in which heat impacts pregnancy?* A 2003 study titled, "A report of heat on embryos and fetuses" in the *International Journal of Hyperthermia* states, "hyperthermia during pregnancy can cause embryonic death, abortion, growth retardation and developmental defects."(28) It further states, "An elevation of maternal body temperature by 2 degrees Centigrade [3.6 degrees Fahrenheit] for at least 24 hours during fever can cause a range of developmental defects."(29) The report noted that necessary data to draw conclusions on exposure times less than 24 hours were lacking (30), leaving open the possibility that elevated maternal temperatures for shorter periods may adversely affect fetuses.

A study reported in the *Journal of the American Medical Association (JAMA)* found that "women who used hot tubs or saunas during early pregnancy face up to triple the risk of bearing babies with spina bifida or brain defects."(31). Hot tubs and baths present greater dangers than other heat therapies such as saunas and steam rooms because the immersion in water foils the body's attempt to cool off via perspiration, in much the same way fetuses cannot escape elevated temperatures in the womb.

All of this taken together establishes the fact that heat, whether caused by elevated maternal temperature or by an ultrasound transducer that remained over one area too long, can set into motion damaging changes in a developing baby. *Using common sense, why would anyone think that intruding upon the continuous, seamless development of the fetus, which has for millions of years completed its work without assistance, be without consequences?*

### **Vaccine and Thimerosal Controversy**

Despite long-standing evidence that ultrasound induces thermal effects and that thermal effects can harm fetal brain development, the cause of autism has remained so elusive to researchers that many autism societies use a puzzle piece as part of their logos. Particularly confounding is the fact that ASD plagues the children of high-income, well-educated families who have the best obstetrical care money can buy. *Why would women who took their prenatal vitamins, observed healthy diets, refrained from smoking or drinking and attended all regularly scheduled prenatal visits bear children with profound neurologically based problems?*

Some believe that childhood vaccines, at first available only to those who could afford them, cause autism. Many vaccines contained thimerosal, a mercury-based preservative, which was thought to have a cumulative neurotoxic effect on children, especially as the number of childhood vaccines increased during the same period of years that the prevalence of autism increased. However, after an exhaustive review in 1999, the FDA found no evidence of harm in the use of thimerosal in childhood vaccines.(32)

Despite those findings, that same year the FDA, NIH, CDC, Health Resources and Services Administration (HRSA) and American Academy of Pediatrics (AAP) together urged vaccine manufacturers to reduce or eliminate thimerosal in childhood vaccines.(33) Pharmaceutical companies complied, and ultimately reduced the infant thimerosal exposure by 98%.(34)

Interestingly, not only did autism rates fail to decrease, they continued to increase. ASD increases are between 10 to 17 percent every year, according to the Autism Society of America (35), indicating that thimerosal is not to blame.

Thimerosal was not the only area of concern in the vaccine-autism controversy. Many people believed that a correlation existed between the triple vaccine MMR (mumps, measles and rubella) and ASD. However, a large, retrospective epidemiological study of more than 30,000 children in Japan between 1988 and 1996 found that the autism rate continued to climb after the vaccine was withdrawn.(36) Those results were no different than the outcome of a 1999 study published in *The Lancet*, that showed no corresponding jump in autism in the UK after the introduction of the MMR vaccine.(37)

A 2001 study published in *JAMA* examining California autism and MMR vaccination rates said the results did "not suggest an association between MMR immunization among young people and an increase in autism occurrence."(38) While concerns about vaccines and mercury exposure should not be dismissed, evidence to date does not implicate either one as a major factor in the explosion of ASD cases.

### **Global Autism Epidemic**

Statistics on the increase of autism worldwide among industrialized nations show that it has emerged in just the last few decades across vastly different environments and cultures. *What do countries and regions with climates, diets and exposure to known toxins as disparate as the US, Japan, Scandinavia, Australia, India and the UK have in common?* No common factor in the water, air, local pesticides, diet or even building materials and clothing can explain the emergence and relentless increase in this serious, life-long neurodevelopmental disorder.

What all industrial countries do have in common is the quiet yet pervasive change in obstetrical care: All of them use routine prenatal ultrasound on pregnant women.

In countries with nationalized healthcare, where virtually all pregnant women are exposed to ultrasound, the autism rates are even higher than in the US, where due to disparities in income and health insurance, some 30 percent of pregnant women do not yet undergo ultrasound scanning.

## The Changes in Ultrasound

In considering initial studies indicating that prenatal ultrasound is safe, one must factor in the ways in which the technology and its applications have continually changed and how that has altered the potential exposure of unborn children. Besides the huge increase in allowable acoustic output in the early 1990s, the following changes have made the field of prenatal ultrasound riskier than ever:

- The number of ultrasound scans conducted during each pregnancy has increased, with women often receiving two or more scans even in low-risk situations.(39) Women in "high-risk" situations may receive many more scans—which, ironically, may raise their risk.
- The range of time within an embryo or fetus's development when ultrasound is performed has extended to very early in the first trimester and continues into the third trimester, right up to delivery. Fetal heart monitors that are used prior to delivery—sometimes for hours—have not been shown to reduce neurological problems and may increase them.(40)
- The development of the vaginal probe, which positions the beam of sound much closer to the embryo or fetus, may put it at higher risk.
- The use of Doppler ultrasound, which is used to study blood flow or to monitor the baby's heart-beat, has increased. According to the 2006 Cochrane Database of Systematic Reviews, "routine Doppler ultrasound in pregnancy does not have health benefits for women or babies and may do some harm."(41)

## Increasingly Common Birth Defects

Dr. Rakic's research team, cited earlier in this article for its recent study on mouse brains and ultrasound, pointed out that "the probe was held stationary for up to 35 minutes, meaning that essentially the entire fetal mouse brain would have been continually exposed to the ultrasound for 35 minutes...in sharp contrast to the duration and volume of the human fetal brain exposed by ultrasound which will typically not linger on a given tissue volume for greater than one minute."(42) This is an excellent point, which is worth pursuing.

One of the most popular non-medical uses of ultrasound, which can extend a medically indicated session, is to determine the sex of the baby. *Could this have a connection to the increase in birth defects involving the genitals and urinary tract?* The March of Dimes says that these types of birth defects affect "as many as 1 in 10 babies," adding that "specific causes of most of these conditions is unknown."(43)

Following this line of thought, consider what other parts of the body are scrutinized by ultrasound technicians, such as the heart, where serious defects have soared nearly 250 percent between 1989 and 1996.(44) The list of unexplained birth defects is not a short one, and in light of what is emerging about prenatal ultrasound, scientists should take another look at all recent trends, as well as the baffling 30% increase in premature births since 1981, now affecting one in every eight children (45), with many showing subsequent neurological damage.(46)

Although many claim that ultrasound benefits outweigh the risks, that statement has no basis and much evidence is to the contrary. A large randomized trial of 15,151 pregnant women, conducted by the RADIUS Study Group, found that in low-risk cases, high-risk subgroups and even in cases of multiple gestations or major anomalies, the use of ultrasound did not result in improved outcome in the pregnancies.(47) The argument that ultrasound is either reassuring to the parents or provides an early opportunity for bonding pales in the face of the possible risks that are emerging as new data become available. Parents and health practitioners may not be able to easily turn away from this window on the womb and resume more traditional practices in obstetrics and midwifery. However, with the disturbing trend in autism and other equally troubling, unexplained birth-related trends, it does not make sense to blindly employ a technology that is not reliably safe for unborn babies.

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- [Ultrasound: Weighing the Propaganda Against the Facts](#) - by Beverley Lawrence Beech
- [Ultrasound: More Harm than Good?](#) - by Marsden Wagner
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