How environmental factors may affect the brain

In February 2008, the economist Paul Krugman commented on findings from neuroscientists in The New York Times. Children growing up in very poor families with low social status experience high levels of stress hormones that may impair brain development and cognitive functioning. He added that in 2006, 17.4% of children in America lived under the poverty line. Based on statistics, he argued that children born to the poorest parents have an almost 50% risk of staying there. This is particularly true for minority children.

Genetics, environmental, and social factors interact in complex ways to determine how the brain develops and functions. It is well known that the developing child and small children are particularly vulnerable to the damaging effects of environmental agents such as lead, mercury, pesticides, solvents, alcohol and tobacco. Exposure to these neurotoxicants during pregnancy and childhood may interfere with the normal development of the brain and contribute to general dysfunction. Problems such as learning difficulties and disorders like fetal alcohol syndrome are consequences of environmental factors on the developing brain.

One way that environmental agents disrupt brain development is by interfering with the processes that control gene activity. It has for example been found that the compound bisphenol A, which is an ingredient in many plastic containers can affect how the genes that are important for controlling brain development are turned on. This environmental agent alters the expression of genes that are important for long-term memory formation and for early brain development. When fetal mice are exposed to extremely low doses of bisphenol it causes major changes in their adult behaviour. When a pregnant woman is abusing alcohol her child will suffer irreversible damage to the brain. Environmental agents can interfere with any one of many steps of brain development, for example cell division, differentiation and specialization of cell types, establishment of connections with or brain cell or death of cells. Environmental agents can also interfere with chemical messengers in the brain that facilitate neural transmission.

Lead and alcohol are known to interfere at several points in brain development. Lead exposure during infancy and childhood can cause attention problems, hyperactivity, impulsive behaviour, reduced IQ, poor school performance, aggression, and antisocial behaviour. Lead paint and lead-contaminated water and soil are the major sources of lead exposure to children. Alcohol crosses the placenta and interferes negatively with brain development – especially in the early period of pregnancy. Depending on the timing and amount of exposure to alcohol, the fetus may develop hyperactivity, learning problems, low IQ and even mental retardation.

Researchers have found that poverty is one of the major risk factors in children’s cognitive development. Factors such as poor nutrition, poverty related health problems, home environment, parenting practices, and living in poor neighborhoods with high levels of crime and unemployment are all factors that may impact brain development in children and therefore influence possibility of education. The effects of under-nutrition may in fact begin already before the child is born. Pregnant women who are undernourished are more likely to give birth to underweight babies who are generally
more at risk. Research in the USA show that poor children are more likely to experience growth stunting and problems with cognitive development than more privileged children. Poor children are also more likely to be exposed to lead poisoning because they live in environments where the risk of lead poisoning is high. Lead poisoning is known to result in learning disabilities, lower IQs, speech and hearing problems and behavioural problems. All these problems are long-term problems that may not be reversible.

Undernutrition in combination with other environmental factors can thus permanently not only affect physical growth but also brain development and cognitive functioning. Inadequate food intake simply limits children’s ability to learn. Children that are chronically undernourished become less active and show less interest in their social environment and they exhibit less emotional expression. This affects their cognitive development. It is believed that it is not the malnutrition alone that results in cognitive malfunctioning but rather the combined negative effects of exposure to undernutrition and other consequences of poverty. If children are given appropriate food and stimulation, it can modify cognitive impairment caused by earlier malnutrition. Nutrition and prenatal care for pregnant women, school breakfast programmes and special food supplement programmes for women and children have positive effects on the cognitive development of children according to Ernesto Pollitt, professor of pediatrics at the University of California.

One third of children from low-income communities who enters kindergarten are behind their peers; by fourth grade 50% of these children do not meet the standard for reading proficiency according to the National Center for Children in Poverty (2002). Wertheimer (2003) found that children from poor families were less likely to be identified as academically gifted, more likely to repeat a grade in school, less likely to participate in extracurricular activities and more likely to suffer from learning disabilities and developmental delays compared to children who are not living in poverty.

**Your baby's brain on drugs (and alcohol and tobacco)**


Although behavioral studies clearly indicate that exposure to drugs, alcohol and tobacco in utero is bad for a baby’s developing brain, specific anatomic brain effects have been hard to tease out in humans. Often users don’t limit themselves to one substance, and demographic factors like poverty can also influence brain development.

Now, an NIH-funded study using magnetic resonance imaging (MRI) brain scans, led by Children’s Hospital Boston neurologist Michael Rivkin, MD, suggests that prenatal exposure to cocaine, alcohol, marijuana or tobacco (alone or in combination) may have effects on brain structure that persist into early adolescence. The findings, published in the April issue of *Pediatrics*, are of public health significance, the researchers say, since it’s estimated that more than 1 million babies born annually in the United States have been exposed to at least one of these agents in utero.

Researchers at Children’s and Boston Medical Center employed volumetric MRI imaging to study the brain structure of 35 young adolescents prenatally exposed to
cocaine, marijuana, alcohol or tobacco. The children, who averaged 12 years old at the
time of imaging, were part of part of an historic cohort of children assembled by Deborah
Frank, MD at Boston Medical Center and followed there since birth. Prenatal exposures
were confirmed by a combination of maternal history, urine testing of the mother or urine
or meconium (stool) testing of the infants at birth. “We found that reductions in cortical
gray matter and total brain volumes were associated with prenatal exposure to cocaine,
alcohol or cigarettes,” says Rivkin, who is first author on the study. “Importantly,
although volume reductions were associated with each of these three prenatal exposures,
they were not associated with any one of these substances alone after controlling for other
exposures.”

Notably, the effects were found to be additive – the more substances a child was exposed
to in utero, the greater the reduction in brain volume. Rivkin notes that the study is also
the first to document joint long-term neuroanatomic effects on the brain of prenatal
cocaine, cigarette and alcohol exposures. Moreover, while previous studies have
documented brain effects of prenatal alcohol exposure, these studies were mostly limited
to children with fetal alcohol syndrome, a diagnosis that was excluded in the current
study.

Although the researchers initially set out to study cocaine exposure, they were struck by
the finding of brain effects of prenatal tobacco exposure. “Approximately 20 percent of
women who smoke continue to smoke during pregnancy,” Rivkin says. “From the
vantage point of preventive health care, it is important to determine the consequences on
brain structure of prenatal exposure to cigarettes, alone and in combination with other
substances.” Rivkin emphasizes that the number of children studied was too small to
find statistically significant effects of single substances after controlling for exposure to
other agents. The study was also too small to consider the effects of different levels of
exposure. But the overall results are highly suggestive. “We’re hopeful to be able to study
the whole sample of 150 children followed at Boston Medical Center, which will permit
such determinations,” Rivkin says.

Both researchers suggest that health care providers should offer pregnant women
comprehensive care to help them reduce use of all psychoactive substances. Public health
campaigns should not ignore the risks of some substances while focusing on others, as it
may well be that the greater the number of total prenatal exposures, the higher the chance
there will be adverse and lasting consequences for the developing brain.

Source: Children's Hospital Boston

See more here http://brainmind.com/Environment.html
http://www.neuroscience.cam.ac.uk/research/cameos/GeneticBrain.php
http://www.childtrauma.org/ctamaterials/trau_CAMI.asp childhood trauma and the brain