CRIME Times

Linking Brain Dysfunction to Disordered/Criminal/Psychopathic Behavior

Volume 13, Number 2, 2007

CRIME TIMES SPECIAL FEATURE

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The Effects of Diet and Toxins on the Brain

— pages 1-5 —

Moms' seafood intake powerfully affects children's outcomes

A diet high in seafood is strongly linked to better neurological outcomes in children, according to a large-scale British study recently published in *The Lancet*.

A great deal of controversy currently surrounds the issue of seafood consumption during pregnancy, because fish is often high in mercury—a potent neurotoxin that can alter early brain development. Because of this, the U.S. government recommends that pregnant women limit consumption of seafood to 12 ounces per week. However, seafood is a major source of omega-3 fatty acids, which are essential for early brain development. Many experts believe the modern Western diet contains far too little of these nutrients.

To determine if seafood's benefits outweigh its risks, Joseph Hibbeln and colleagues analyzed information from nearly 9,000 British families participating in the "Children of the 90s" project conducted by the University of Bristol.

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High prenatal manganese linked to behavior problems

Prenatal exposure to high levels of manganese is linked to an increased risk for a wide range of behavior problems, according to a new study.

Jonathon Ericson and colleagues tested shed molar teeth from 27 children between the ages of 11 and 13, all participants in a long-range study of child development. The researchers note that tooth enamel provides a good measure of manganese accumulation over a long period, "analogous to levels of pollutants recorded in tree rings." The cusp tip of the first molar, they say, provides a record of manganese exposure during the 20th week in utero, while the root tip of the molar provides a record of exposure seven months after birth.

> Erickson et al. say that children exposed to higher prenatal manganese had worse scores on every measure of behavioral disinhibition at every age they were tested.

As part of the overall study, the researchers evaluated children's behaviors using different methods at different ages. The evaluations included:

—The "Forbidden Toy Task," a measure of the ability to inhibit impulsive reactions by obeying a request to avoid a particular toy, administered when the children were three years old.

—The Mirsky Continuous Performance Test (CPT), administered at 54 months of age to measure sustained attention and impulse control.

—The Children's Stroop Test, also given at 54 months to measure the ability to inhibit incorrect behavior.

—Questionnaires about the children's behavior filled in by parents and teachers when the children reached 1st and 3rd grades.

The researchers report, "Children with higher prenatal manganese levels received higher scores on all measures of behavioral disinhibition: they played more with the forbidden toy at 36 months, made more impulsive errors on the CPT and Stroop test at 54 months, were rated by their mothers and teachers as having more externalizing and attention problems in 1st and 3rd grades, and were rated by their teachers as having more disruptive behavior disorders (attention deficit hyperactivity disorder [ADHD], hyperactivity/impulsivity, inattention) in third grade." In addition, mothers (but not teachers) rated children with higher manganese exposure as having more internalizing problems such as depression or anxiety.

Manganese levels at the age of seven months correlated with later behavior problems only on the teachers' evaluations, suggesting that exposure at this age had less effect. IQ tests did not correlate with manganese levels—an expected finding, the researchers say, because animal studies indicate that excess manganese affects behavior but not intelligence.

Ericson and colleagues say the effects of manganese may stem from its effects on the dopamine system. Altered dopamine levels are strongly linked to impulsivity and ADHD, and

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Lead's harmful effects on behavior are independent of IQ

High lead levels can cause behavior problems independently of the toxin's effects on IQ, according to a new study which reports that children with higher lead levels at age 7 are more likely to exhibit aggression and other "acting out" behaviors.

Aimin Chen and colleagues analyzed data from a clinical trial involving 780 children with high blood lead levels. Data included IQ scores, behavioral scores, and blood lead levels at various ages. (The study was designed to test the effects of a drug treatment which proved disappointing.)

The researchers report that higher blood lead levels at age 7 correlated with increases in overall behavioral symptoms, "externalizing" (acting-out) behaviors, and school problems. This remained true when the researchers controlled for lead's effects on IQ. Children's lead levels at age 2, however, did not correlate with later behavior problems at age 7.

The researchers say, "The results suggest that prevention of lead exposure should continue into later childhood and not cease soon after peak blood lead level begins to fall at approximately age 3."

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"Lead exposure, IQ, and behavior in urban 5- to 7-year-olds: Does lead affect behavior only by lowering IQ?" Aimin Chen, Bo Cai, Kim N. Dietrich, Jerilynn Radcliffe, and Walter J. Rogan, *Pediatrics*, Vol. 119, 2007, 650-58. Address: Walter J. Rogan, Epidemiology Branch, National Institute on Environmental Health Sciences, MD A3-05, P.O. Box 12233, Research Triangle Park, NC 27709, rogan@niehs.nih.gov.

Manganese, children's behavior problems linked

(continued from page 1)

a recent study led by Francis Crinella (who also participated in the current study) found that exposing rats during infancy to high levels of manganese led to depletion of dopamine in a brain area associated with ADHD.

The researchers suggest that some children are over-exposed to manganese before birth because their mothers are iron-deficient. Iron deficiency, which affects more than half of all pregnancies worldwide, can cause excess absorption of manganese.

One potential source of significant amounts of manganese after birth is soy infant formula, which can contain as much as 80 times the amount of manganese as breast milk (see *Crime Times* Volume 5, Number 1, 1999, p. 3).

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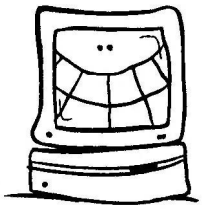
"Prenatal manganese levels linked to childhood behavioral disinhibition," Jonathan Ericson, Francis Crinella, K. Alison Clarke-Stewart, Virginia Allhusen, Tony Chan, and Richard Robertson, *Neurotoxicology and Teratology*, September 27, 2006 (advance online publication). Address: Francis Crinella, Irvine Child Development Center, University of California, 19722 MacArthur Blvd., Irvine, CA 92612, fmcrinel@uci.edu.

QUOTABLE

"There've been a lot of clues to this relationship [between lead and behavior problems], but the more studies that point to it, the better, because then maybe people will take it seriously....If I'm a little dull, that's bad, but if I'm a criminal, that's worse."

—Lead toxicity expert and Crime Times *Professional Advisory Board Member Herbert Needleman, commenting in the* Philadelphia Inquirer *on research by Aimin Chen et al. (see article on this page).*



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Can cholesterol help protect against damage done by exposure to alcohol in the womb?

A study of zebrafish suggests that a simple intervention may help to protect unborn children against the damage done by mothers who drink alcohol during pregnancy.

Yin-Xiong Li and colleagues found that exposing zebrafish embryos to low levels of alcohol during very early development blocked the modification of a crucial developmental protein, Sonic Hedgehog (Shh), by cholesterol. The modification of Shh by cholesterol plays a critical role in enabling the protein to guide cell formation and differentiation and embryonic "patterning." Shh is key to the development of the neural tube and early cardiac, gut, and limb structures—all areas affected in fetal alcohol syndrome.

The current study found that alcohol-exposed zebrafish showed defects very similar to those seen in humans exposed to alcohol in utero, including neurological, heart, cranial, and limb malformations. Defects occurred even at very low levels of fetal tissue alcohol concentration, equivalent to those reached if a 120-pound woman ingests a single beer. "This may explain," the researchers say, "why alcohol is the most common teratogen responsible for human congenital defects, and suggests that there is no safe level of alcohol consumption during pregnancy."

The alcohol-exposed zebrafish embryos had reduced cholesterol levels, and when the researchers supplemented the embryos with cholesterol before exposing them to alcohol, Shh performed normally and the fish developed correctly. Thus, the researchers say, cholesterol supplementation appears to correct alcohol-induced Shh defects "at the molecular, cellular, and developmental levels."

Thousands of babies are born each year with neurological damage due to fetal alcohol exposure, which can cause problems ranging from learning and behavioral disabilities to severe retardation. Prenatal exposure to alcohol also is one of the leading risk factors for juvenile delinquency and adult criminality. While only abstinence from alcohol during pregnancy can prevent prenatal alcohol effects, the current study suggests that intervention before birth can reduce the risk of permanent defects. Previous studies (see *Crime Times* Vol. 12, No. 2, 2006, page 3 and Vol. 7, No. 2, 2001, page 5) also indicate that prenatal administration of vitamin B3 or choline can help reduce this risk (see related articles on pages 5 and 7).

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"Fetal alcohol exposure impairs hedgehog cholesterol modification and signaling," Yin-Xiong Li, Hai-Tao Yang, Marzena Zdanowicz, Jason K. Sicklick, Yi Qi, Terese J. Camp, and Anna Mae Diehl, *Laboratory Investigation*, January 22, 2007 (online publication). Address: Yin-Xiong Li, Dept. of Medicine, Duke University Medical Center, Snyderman-GSRB I, Suite 1073, 595 LaSalle St., Box 3256, Durham, NC 27710, yinxiong.li@duke.edu.

Seafood strongly benefits children's behavior, development

(continued from page 1)

Included were data on pregnant women's fish consumption and the behavior and development of their children up to age 8. In evaluating the data, the researchers controlled for 28 factors, including socioeconomic status and breastfeeding, which could influence their findings.

Hibbeln and colleagues report that mothers who ate more seafood than current U.S. guidelines recommend had children who were more advanced in motor, communication, and social skills as toddlers; exhibited better social behaviors; and were less likely to have low verbal IQ scores at the age of 8. Conversely, the children of mothers who ate no fish at all were more likely to have poor communication skills at 18 months; to have poor fine motor skills at age 3; to have poor social behavior at age 7; and to have relatively low verbal IQs at age 8, when compared to children of mothers who exceeded the guidelines for seafood consumption.

The researchers conclude, "Maternal seafood consumption of less than 340 grams [12 ounces] per week in pregnancy did not protect children from adverse outcomes; rather, we recorded beneficial effects on child development with maternal seafood intakes of more than 340 grams per week, suggesting that advice to limit seafood consumption could actually be detrimental."

The current report is one of many linking increased intake of omega-3 fatty acids to improved child behavior and cognition (see *Crime Times* Vol. 12, No. 4, 2006, p. 7 and Vol. 12, No. 1, 2006, p. 1).

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"Maternal seafood consumption in pregnancy and neurodevelopmental outcomes in childhood (ALSPAC study): an observational cohort study," J. R. Hibbeln, J. M. Davis, C. Steer, P. Emmett, I. Rogers, C. Williams, and J. Golding, *The Lancet*, Vol. 369, No. 9561, February 17, 2007, 578-85. Address: jhibbeln@mail.nih.gov.

—and—

"Research shows that the benefits of eating seafood during pregnancy outweigh the risks," news release, Avon Longitudinal Study of Parents and Children (Children of the 90s), February 16, 2007.

Smarter piglets show importance of breast milk nutrient low in commercial formulas

Breastfeeding builds smarter babies, according to many studies—and the benefits of breastfeeding appear strongest for premature infants. New research suggests one reason: compared to infant formulas, breast milk contains much higher concentrations of sialic acid.

Bing Wang and colleagues note that sialic acid plays a critical role in cell migration, the formation of synapses between neurons, and learning. Because the body's ability to create sialic acid is limited, they say, a dietary source of sialic acid "may be critical under conditions of extremely rapid brain growth, particularly during the first months after birth."

The researchers studied the effects of sialic acid supplementation on infant pigs, selected because their brain structure and function during development are similar to those of humans. In addition, their digestive systems are similar in many ways, and they have comparable nutrient needs. Because newborn pigs are developmentally immature and small compared to adult pigs, they also are a good model for low-birth-weight infants.

The researchers divided 54 pigs into four groups: a control group receiving standard sow milk formula containing very little sialic acid, and three groups receiving formula supplemented with different amounts of the nutrient. When the pigs were three weeks old, the researchers tested their learning skills and memory using easy and difficult variants of a task in which the pigs had to find the one arm of an eight-arm maze that contained accessible milk.

"In both the easy and difficult tasks, the sialic acid-supplemented groups reached the learning criterion faster than did the control group," the researchers say. In the easy version, more than 70 percent of piglets in the three supplemented groups mastered the task, compared to only 45 percent of non-supplemented piglets. In the difficult version, 100 percent of piglets who received the highest amount of sialic acid mastered the task, compared to only 70 percent of the controls. In that trial, piglets receiving higher doses of sialic acid performed better than those getting lower doses.

> Bing Wang and colleagues suggest that adequate sialic acid may be particularly crucial for premature or low-birth-weight infants. Prematurity and low birth weight are strong risk factors for learning, behavior, and motor problems in later life.

In the second stage of the task—measuring how well the piglets remembered the maze two days later—the supplemented groups performed better than the controls on the difficult task (although not on the easy one), with no effects of increasing doses seen. The findings for both phases of the task held true when the researchers adjusted for the piglets' body weights and rate of weight gain. The researchers also found that sialic acid supplementation increased expression of two genes associated with learning, and increased concentrations of protein-bound sialic acid in the frontal cortex.

Their findings, they say, show "concurrent links among dietary intake, gene expression, brain biochemistry, and learning behavior." They conclude that "the relatively small amount of sialic acid in infant formulas is of concern" and recommend that researchers investigate the effects of adding larger amounts of sialic acid to infant formulas—particularly those given to low-birth-weight and premature infants.

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"Dietary sialic acid supplementation improves learning and memory in piglets," Bing Wang, Bing Yu, Muhsin Karim, Honghua Hu, Yun Sun, Paul McGreevy, Peter Petocz, Suzanne Held, and Jennie Brand-Miller, *American Journal of Clinical Nutrition*, Vol. 85, No. 2, February 1, 2007, 561-69. Address: J. Brand-Miller, Human Nutrition Unit, School of Molecular and Microbial Biosciences, G08, University of Sydney, NSW, 2006, Australia, j.brandmiller@mmb.usyd.edu.au.

—see also—

"Is sialic acid in milk food for the brain?" Muhsin Karim and Bing Wang, *CAB Reviews*, Vol. 1, No. 18, May 2006. Address: b.wang@mmb.usyd.edu.au.

Why Crime Times?

The more we learn about the brain dysfunction that underlies much delinquency and criminal behavior, the more successful we will be in truly rehabilitating offenders and preventing at-risk children from turning to lives of crime. The purpose of *Crime Times*, a free publication sponsored by the Wacker Foundation, is to foster this effort by reporting state-of-the-art worldwide research on biological causes and treatment of aberrant behavior. It is our hope that physicians, researchers, educators, law enforcement professionals, and parents can use the information in *Crime Times* to build a better, safer future for at-risk children and for the communities in which they live.

Choline again shown to counter behavior, learning problems caused by prenatal alcohol

A new study adds to research showing that the B vitamin choline may help to counter some of the damage done by prenatal exposure to alcohol.

Jennifer Thomas and colleagues note that despite increasing knowledge about alcohol's devastating effects on behavior and IQ, many women ignore warnings to abstain from drinking during pregnancy. Thus, the researchers say, it is imperative for researchers to identify treatments to help children born with deficits due to alcohol exposure.

Earlier research by Thomas and colleagues found that alcohol-exposed rat pups treated with choline after birth performed as well as non-exposed rats on a test of learning and memory, while exposed pups who did not receive choline showed marked impairments (see *Crime Times* Volume 7, No. 2, 2001). The current study showed that giving choline to rat pups exposed to alcohol during the equivalent of the third trimester of human pregnancy significantly reduced the severity of alcohol-related hyperactivity and spatial learning deficits. Choline's benefits were still apparent months after the rats stopped receiving choline, indicating that the effects of the nutrient are long-lasting. Also, even relatively low doses of the nutrient were effective. However, choline did not prevent the occurrence of motor problems linked to alcohol exposure.

"These data indicate that choline supplementation can alter brain development following a developmental insult," Thomas and colleagues say. "Moreover, the data suggest that early dietary interventions may reduce the severity of some fetal alcohol effects, even when administered after birth."

However, Thomas cautions, "Choline is not going to be a panacea for all symptoms of fetal alcohol spectrum disorders. Women need to be continually reminded of the damaging effects of alcohol on the developing fetus."

Fetal alcohol spectrum disorders (FASD) are one of the most common causes of mental retardation, learning problems, and disruptive behavior and are strongly linked to juvenile delinquency and adult criminality. (See related stories on pages 3 and 7.)

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"Choline supplementation following third-trimester-equivalent alcohol exposure attenuates behavioral alterations in rats," J. D. Thomas, J. S. Biane, K. A. O'Bryan, T. M. O'Neill, and H. D. Dominguez, *Behavioral Neuroscience*, Vol. 121, No. 1, February 2007, 120-30. Address: Jennifer Thomas, Department of Psychology, San Diego State University, San Diego, CA 92120, thomas3@mail.sdsu.edu.

Low-dose toxins harm crucial cells via common pathway

Toxins can harm nervous system cells at very low doses, according to a new study revealing that different toxins follow a common pathway that leads to cell damage.

Zaibo Li and colleagues exposed one type of stem cell in the central nervous system to three different toxins: methylmercury, lead, and the herbicide paraquat. The stem cells they tested play a critical role in the growth, development, and function of the central nervous system.

All three toxins, the researchers say, disrupted cell function by increasing a cell-damaging process called oxidation. This triggered a chain reaction that eventually inhibited signaling pathways needed for cell division.

"These toxicants are activating a normal cellular regulatory pathway," says study coauthor Mark Noble, "they are just activating it inappropriately. If this disruption occurs during critical developmental periods, like fetal growth or early childhood, it can have a significant impact. Development is a cumulative process, and the effects of even small changes in progenitor cell division and differentiation over multiple generations could have a substantial effect on an organism."

Li and colleagues comment, "Development is a cumulative process, and the effects of even small changes in progenitor cell division and differentiation over multiple generations could have a substantial effect on an organism."

The researchers add, "[T]he changes we observed were seen at environmentally relevant exposure levels for both methylmercury and lead." Deleterious effects of methylmercury, for example, occurred at levels 90 percent lower than exposure levels generally considered low to moderate.

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"Chemically diverse toxicants converge on Fyn and c-Cbl to disrupt precursor cell function," Zaibo Li, Tiefei Dong, Chris Pröschel, and Mark Noble, *PLoS Biology*, online publication, February 5, 2007. Address: Mark Noble, University of Rochester, School of Medicine and Dentistry, 601 Elmwood Ave., Box 633, Rochester, NY 14642, Mark_Noble@urmc.rochester.edu.

—BOOK REVIEW—

BORN THAT WAY
by William Wright
Routledge, 1999
Paperback, $18.95

An informative and entertaining book, *Born That Way* offers readers insights into both the strong effects of genes on behavior and the politics of scientific debate.

Wright, a lay writer, outlines the evidence showing how profoundly genes influence a wide range of human behavior ranging from aggression to religious views and food preferences. He also devotes much of the book to describing the controversy generated by research into gene-behavior links, and details the ferocity of attempts to vilify or suppress scientists working in this field. While slightly dated—the original hardback came out in 1998—*Born That Way* offers a fascinating look at what happens when new scientific ideas collide with long-held views about sensitive issues.

The book has two quirks that some readers may find irritating. One is Wright's sometimes heavy-handed "good guys vs. bad guys" view of genetic and environmental researchers. Another is his tendency to attribute political views with which he disagrees to hard-wired genetic tendencies, while attributing his own views to logic. Overall, however, *Born That Way* is an engaging book that will bring lay readers up to speed on much of the research showing that our genes powerfully affect who we are and what we do.

(Note: *Are We Hardwired?* By William R. Clark and Michael Grunstein—see *Crime Times*, Vol. 7, No. 4, 2001, p. 6—is another good choice for readers interested in this topic.)

QUOTES FROM *BORN THAT WAY* by William Wright:

"The new genetic perception has a potential for dispelling guilt on both the part of those with behavioral problems and the part of parents who, in the environmental paradigm, have been wrongfully accused of causing it. One's heart goes out to the couple who stares at the floor as a therapist explains that their lack of love and support for their son has turned him into the depressed addict they now confront. Often, they are too cowed by the degree-holder before them and too ashamed of their inevitable parental failings to cite *less* supportive parents whose kids turned out okay."

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"While genes are not all-powerful with behavior, evidence mounts that they are *all-pervasive* in that they appear to influence, to however small a degree, our every thought and action.... In countless studies aimed at sorting out genetic from environmental effects, not one of the numerous traits examined failed to show at least some degree of genetic influence."

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"Whether we welcome or resist a genes-behavior link and whether or not the link is seen to be compatible with this or that political vision, the evidence is now overwhelming that our nature is as much a product of evolution as our physiques, that each of us is born with an array of behavioral dispositions—some noble, some ruthless, some species-wide, some individual, some general, some of a birth-mark specificity—and that the more we know about these internal givens, the more effective we will be at dealing with ourselves, with others, and with the psychological and societal problems that, till now, have proved intractable."

Biology's hand in history: did genetic disease add fire to America's most famous feud?

For generations, the Hatfields and McCoys fought to the death over land rights, timber, and just about everything else. Now, doctors have one possible explanation for the virulence of the legendary feud that broke out in the 1880s between these two Appalachian families.

Researchers have been studying the McCoy family for several decades, because a disorder called von Hippel-Lindau disease (VHLD) occurs at extremely high rates in members of this family. The disorder causes both benign and cancerous tumors, and when these tumors arise in the adrenal gland—where they are called pheochromocytomas—they can cause high levels of stress hormones and symptoms including extreme irritability or anxiety, fast heartbeat, high blood pressure, and severe headaches.

Members of the extended McCoy family recently came forward to make this information public, so that other family members can seek treatment. Revi Mathew, a Vanderbilt University endocrinologist treating one family member, says, "This condition can certainly make anybody short-tempered, and if they are prone because of their personality, it can add fuel to the fire."

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Serotonin gene influences anger, aggression in women

A variant of a gene that affects serotonin function in the brain is linked to aggression and anger in women, according to a recent study.

Indrani Halder and colleagues studied 550 women of European descent, looking for normal variations in genes and behavior. The researcher discovered that women with one or both of two alterations in the "promoter" region of the serotonin receptor 2C gene (located on the X chromosome) typically had lower scores on two tests for anger, hostility, and aggression. Halder says, "The same gene may also be important for understanding anger and aggression in men," although males have only one X chromosome.

Altered levels of serotonin in the brain are linked to aggression, impulsive behavior, depression, substance abuse, and violent suicide, although these relationships are complex.

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"Gene variations contribute to aggression and anger in women," news release, University of Pittsburgh Schools of the Health Sciences, March 9, 2007. Dr. Halder's findings were presented at a conference of the American Psychosomatic Society in Budapest, Hungary, in March 2007.

The Wacker Foundation is interested in hearing from researchers with proposals for research projects. Projects should concern biological influences on disordered, criminal, or psychopathic behavior.

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Did McCoy gene disease contribute to famed feud?

(continued from p. 6)

Rita Reynolds, a McCoy descendent who has the disease, says that doctors studying the family over the decades referred to their condition as "madness disease." (To protect the family's privacy, doctors referred to them in medical journals as the "McC kindred.") Reynolds adds, "Our family would just go off, even on the doctors."

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"Disease underlies Hatfield-McCoy feud," Marilynn Marchione, Associated Press, April 5, 2007.

—see also—

"Pheochromocytoma in von Hippel-Lindau disease: Clinical presentation and mutation analysis in a large, multigenerational kindred," Nuzhet Atuk, Catherine Stolle, John Owen, Jr., Johnson Carpenter and Mary Lee Vance, *Journal of Clinical Endocrinology and Metabolism*, Vol. 83, No. 1, 1998, 117-20. Full text available free of charge at http://jcem.endojournals.org/cgi/content/full/83/1/117.

Alcohol's legacy: study shows binge drinking ups risk for psychiatric problems even in 'non-disabled' offspring

Editor's note: The following article appeared in Crime Times Vol. 12, No. 4, 2006, but was cut off due to a printing error. The entire article appears here. Our thanks to readers who notified us of this misprint.

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Binge drinking during pregnancy can cause Fetal Alcohol Spectrum Disorders (FASD), but most children of drinkers do not suffer from this disorder. A new study, however, adds to evidence that even offspring who appear to suffer no ill effects after heavy prenatal exposure to alcohol are at risk for behavior disorders that increase their odds of life failure or criminality.

Helen Barr and colleagues studied 400 adults (average age 25.7) whose mothers originally participated in a study between 1974 and 1975. The mothers' alcohol consumption during pregnancy was assessed, including whether or not they engaged in "binge drinking" (consuming five or more drinks on at least one occasion).

In their follow-up, Barr and colleagues assessed the subjects for the presence or absence of psychiatric disorders and traits. After controlling for a wide range of potentially confounding factors, they found that compared to other subjects, participants whose mothers engaged in binge drinking at least once during pregnancy had more than twice the risk of being diagnosed with a substance dependence or abuse disorder, passive-aggressive personality disorder or traits, or antisocial personality disorder or traits.

The researchers conclude, "Prenatal exposure to alcohol may be a risk factor for specific psychiatric disorders and traits in early adulthood, even in a non-clinical group."

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"Binge drinking during pregnancy as a predictor of psychiatric disorders on the Structured Clinical Interview for DSM-IV in young adult offspring," Helen M. Barr, Fred L. Bookstein, Kieran D. O'Malley, Paul D. Connor, Janet E. Huggins, and Ann P. Streissguth, *American Journal of Psychiatry*, Vol. 163, No. 6, June 2006, 1061-5. Address: Helen M. Barr, Fetal Alcohol and Drug Unit, University of Washington Medical School, 180 Nickerson Street, Suite 309, Seattle, WA 98109-1631, hbarr@u.washington.edu.

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QUOTABLE "Mr. Demar [formerly a violent, often-incarcerated alcoholic] has been out of trouble and sober for a year now. He has a girlfriend, his own door key, and was made employee of the month at his company recently. Others on the trial also have long histories of violence but with omega-3 fatty acids have been able for the first time to control their anger and aggression. 'J,' for example, arrived drinking a gallon of rum a day and had 28 scars on his hand from punching other people. Now he is calm and his cravings have gone. 'W' was a 19-stone barrel of a man with convictions for assault and battery. He improved dramatically on the fish oil and later told doctors that for the first time since the age of five he had managed to go three months without punching anyone in the head."

Felicity Lawrence, in The Guardian, *October 17, 2006, reporting on a study by Joseph Hibbeln investigating the effects of omega-3 fatty acids on violent alcoholics. The study is still in progress.*

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