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Maternal drinking during pregnancy can damage the earliest fetal learning

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Habituation refers to the ability of an organism to stop responding to repeated stimulation. A new study has examined the impact of maternal drinking on fetal habituation or learning abilities while still residing in the mother's womb. Results showed that those fetuses exposed to heavy binge drinking required significantly more trials to habituate, and also exhibited a greater variability in test performance.

While it has become clear that drinking during pregnancy can damage the fetal central nervous system, these outcomes can also be influenced by factors such as timing, type, amount, and duration of alcohol exposure. Furthermore, most studies of fetal neurobehavioral effects have been conducted during the postnatal period. This study is the first of its kind, examining alcohol's effects on fetal brain function – information processing and stability of performance – at the time of exposure to alcohol.

Results will be published in the December 2012 issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"When examined after birth, individuals who have been prenatally exposed to alcohol exhibit a wide range of behaviours that are indicative of central nervous system dysfunction," explained Peter G. Hepper, a professor of psychology at Queen's University of Belfast as well as corresponding author for the study. "These can include poorer abilities to learn, deficits in attention, poorer abilities to plan and organize, and an

inability to learn about the consequences of actions. As a consequence, they may demonstrate behavioural difficulties and social problems which might lead to problems at school, and often 'trouble with the law.'"

"This study used a process of habituation, which is the ability of an organism to stop responding to repeated stimulation," explained Leo Leader, a senior lecturer in the School of Women's and Children's Health at the University of New South Wales. "This reflects the ability of the central nervous system to learn to recognize a particular stimulus. It is widely accepted that habituation represents a basic form of learning. Previous research has shown that the normal human fetus habituates, but habituation rates are altered if the fetus is exposed to reduced oxygen levels, maternal smoking, maternal sedatives, and impaired fetal growth."

"There have been no other studies looking at the habituation or learning abilities of the individual at the time they are being exposed to alcohol, that is, in their mother's womb," said Hepper. "Essentially, we played a loud two-second sound to the fetus via a speaker on the mother's abdomen. We watched using ultrasound whether the fetus moved, jumped or startled to the sound. The sound was repeated every five seconds and the response of the fetus recorded each time. As the sounds are repeated, the fetus's response got weaker and eventually, after a number of sound presentations, disappeared. At this point the fetus is said to have habituated."

Hepper and his colleagues examined 78 non-smoking mothers with normal, apparently healthy, single pregnancies from the Royal Jubilee Maternity Service in Belfast. Details of the mothers' alcohol consumption were obtained through questionnaires completed at 12 to 14 and 18 to 20 weeks gestation as well as semi-structured interviews at 34 weeks of gestation. Following identification of the mothers' drinking habits, five groups of fetuses were examined: control (n=30), moderate

amounts consumed during the week (n=15), moderate amounts consumed during a binge period (n=13), heavy amounts consumed during the week (n=9), and heavy amounts consumed during a binge period (n=11). Fetal performance was examined on three occasions, seven days apart, beginning at 35 weeks of gestation.

"We have demonstrated that at the time of exposure, alcohol is affecting a fundamental psychological process known as habituation that underlies many of our more complex psychological abilities," said Hepper. "Habituation is a basic but high level psychological process that controls information flow in the brain. For example, when you enter a room for the first time you may be aware of the loud ticking of a clock. However, very quickly you will no longer 'hear' or pay attention to the ticking. The process of habituation has told the brain the ticking]is a non- threatening stimulus and switches attention to other things of merit. How good we are at this is a measure of how well we can process information. The quicker the habituation process, the better able individuals are to process information by turning off attention to irrelevant non-changing stimuli, and focusing attention and awareness on new potentially threatening stimuli."

"Results showed that the fetuses of mothers who binge drink five to 10 drinks per week, or drink more than 20 drinks a week drunk evenly, or as a binge over two to three days take significantly longer to habituate," added Leader. "The study also showed that binge drinking was associated with more variability of the fetus to learn. For normal learning and development, the fetal brain requires stability and this result implies that binge drinking impaired this function."

"One often ignored element of our brain function is its stability in functioning," agreed Hepper. "That is, our brain operates today the same as it did yesterday and will operate the same tomorrow. This is fundamental to our ability to exist and function in the world. Our study

demonstrated that when exposed to alcohol there was increased variability in the brain's ability to habituate. The brain didn't perform the same. By observing these behavioural effects before birth, we can start to identify the areas of brain affected by alcohol and possibly develop treatments. Moreover, by identifying the presence of alcohol-induced problems before birth, it will be possible to implement better management strategies much earlier and hopefully improve outcomes."

Both Hepper and Leader noted that no safe level of alcohol consumption during pregnancy has been identified. "One 'oddity' of prenatal exposure to alcohol is there are large individual differences in its effects," said Hepper. "Some individuals whose mothers drink heavily may exhibit few effects whilst others whose mothers drink less may exhibit much greater effects. By observing the behaviour of the fetus it will be possible to ascertain which and by how much individuals have been affected by exposure to alcohol. To be safe, however, no drinking during pregnancy would be wise."

Provided by Alcoholism: Clinical & Experimental Research

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