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Integrity of the brain's reward system is linked to relapse following treatment

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The brain reward system (BRS) is involved in developing/maintaining addictive disorders, as well as relapse. New findings show that alcohol dependent individuals -- both future abstainers and relapsers -- have significantly thinner cortices in the BRS and throughout the entire brain. Findings support the influence of neurobiological factors on relapse.

At least 60 percent of individuals treated for an alcohol use disorder will relapse, typically within six months of treatment Given that the brain reward system (BRS) is implicated in the development and maintenance of all forms of addictive disorders, this study compared thickness, surface area and volume of neocortical components of the BRS among three groups: light drinkers, alcohol-dependent (AD) individuals still abstinent after treatment, and those who relapsed. Findings support the influence of neurobiological factors on relapse.

Results will be published in the June 2011 issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"The BRS is a collection of regions/structures in the frontal and temporal lobes, limbic system, basal ganglia and other subcortical structures that form a functional network that is involved in determining if a substance or experience is pleasurable or aversive to use – which includes alcohol, food and other substances," explained Timothy C. Durazzo, assistant adjunct professor in the department of radiology at the University of California San Francisco, and corresponding author for the study. "The BRS is also involved in how we behave in response to the pleasurable or

unpleasurable substance or situation"

Durazzo described this network as not only involved in the experience of pleasure and aversion, but also in the regulation of mood, higher-level cognitive abilities such as problem-solving, reasoning, decision-making, planning and judgment, as well as impulse control. "Abnormal BRS biology may also play a major role in the development and persistence of all forms of addiction," he said.

"If the BRS is not healthy or properly developed, this could lead to problems in delaying gratification, keeping emotions from driving decisions, and perceiving rewards in small yet healthy day-to-day events," added Susan F. Tapert, acting chief of psychology at the VA San Diego Healthcare System as well as professor of psychiatry at the University of California, San Diego. "Brain abnormalities therefore could result in more frequent, intense, or harmful intake of alcohol or other intoxicating substances."

Durazzo and his colleagues used magnetic resonance imaging (MRI) to examine BRS components among 75 (71 men, 4 women) treatment-seeking AD individuals at one-week of abstinence and 43 (39 men, 4 women) controls. The AD participants were followed for 12 months after the baseline examination, and classified as abstainers (n=24, no alcohol consumption) and relapsers (n=51, any alcohol consumption).

"We wanted to determine if at the beginning of treatment there were structural differences in the cortex of those who were able to maintain sobriety for at least 12 months after treatment versus those who relapsed within 12 months of treatment," said Durazzo. "We found that … the AD individuals – both future abstainers and relapsers – had significantly thinner cortices in the BRS and throughout the entire brain. However, the relapsers showed lower surface area and volume in the BRS than abstainers and controls. Overall, our results also indicated that the

relapsers showed the most substantial structural abnormalities in the BRS."

Another important finding, added Durazzo, was that in AD participants who ultimately relapsed, those with the greater volume and surface area in several regions of the BRS had a less severe relapse. "That is, the length of relapse was shorter and they consumed less alcohol during the relapse," he said.

Durazzo added that these findings suggest that individuals who demonstrate the greatest degree of neurobiological abnormalities in the BRS at the beginning of treatment may be most at risk for relapse. "Specifically, impairments in the normal function of the BRS are associated with compromised problem-solving, reasoning, decision-making, planning and judgment, mood and impulse control," he said. "This may interfere with the ability to deal with the stressors and demands of everyday life and leave individuals more vulnerable to relapse."

"These individuals may have fewer neural resources dedicated to the ability to refrain from doing unhealthy activities or from postponing rewards," said Tapert. "This smaller volume and surface could also indicate that there are fewer brain cells available for finding small, frequent rewards throughout the day, so that more impactful experiences such as intoxication are sought out in order to provide the individual with a feeling of reward."

Both Durazzo and Tapert noted that this field of research is in its beginning stages. "It seems that MRI-based neuroimaging research can assist in identifying abnormalities in brain biology that may serve as markers for increased risk of relapse," said Durazzo. "Current medications and psychosocial interventions for AUD are only modestly effective in promoting long-term abstinence. Neuroimaging techniques

can promote a better understanding of the neurobiological factors associated with relapse."

"A variety of brain imaging findings are emerging that can be used to help predict which patients may need a longer alcoholism treatment inpatient stay, or more intensive aftercare, or a more carefully designed follow-up plan to help prevent relapse," said Tapert. "For example, individuals with a smaller size of some reward-related frontal brain areas may need external constraints to help them keep from returning to heavy drinking."

"A substantial amount of research has investigated the psychological, psychiatric, sociodemographic and behavioral factors associated with relapse following treatment, but how brain biology and function contribute to relapse is not well understood," said Durazzo. "This neuroimaging research indicates that further study of how brain biology and function contribute to relapse is necessary to develop more effective medications and behavioral treatments for addictive disorders."

Provided by Alcoholism: Clinical & Experimental Research