# Recovery of brain volumes with abstinence may vary for different brain regions

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Chronic alcohol abuse can severely damage the nervous system, particularly cognitive functions, cerebral metabolism, and brain morphology. Building upon previous findings that alcoholics can experience brain volume recovery with abstinence, this study found that recovery of cerebral gray matter (GM) can take place within the first two weeks of abstinence, but may vary between brain regions.

Results will be published in the January 2013 issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"Shrinkage of brain matter, and an accompanying increase of cerebrospinal fluid, which acts as a cushion or buffer for the brain, are well-known degradations caused by alcohol abuse," explained Gabriele Ende, professor of medical physics in the Department of Neuroimaging at the Central Institute of Mental Health. "This volume loss has previously been associated with neuropsychological deficits such as memory loss, concentration deficits, and increased impulsivity."

"Several processes likely account for changes in brain tissue volume observed through bouts of drinking and abstinence over the course of alcoholism," added Natalie May Zahr, a research scientist in the Department of Psychiatry and Behavioral Sciences at Stanford University School of Medicine. "One process likely reflects true, irreversible neuronal cell death, while another process likely reflects shrinkage, a mechanism that would allow for volume changes in both

negative and positive directions, and could account for brain volume recovery with abstinence."

"Gray matter (GM) and white matter (WM) are the main components of the brain that can be distinguished with magnetic resonance imaging (MRI)," explained Ende. "GM consists of neuronal cell bodies, neuropil, glial cells, and capillaries. WM mostly contains myelinated axon tracts."

"Myelin forms an insulating sheath around axons that increases the speed at which they are able to conduct electrical activity," added Zahr. "Because myelin is composed primarily of fat, it gives white matter its color. Cerebrospinal fluid (CSF) is a clear fluid that surrounds and thereby cushions the brain in the skull. Conventional brain structural MRI produces images of protons, with contributions primarily from water and some from fat. Tissue contrast is possible because of the fundamental differences in water content in the primary tissues of the brain: WM consists of about 70 percent water, GM 80 percent, and CSF 99 percent."

Ende and her colleagues examined 49 alcohol dependent (AD) patients (40 males, 9 females) from an inpatient alcohol-withdrawal treatment program as well as 55 non-AD but age- and gender-matched individuals or controls (42 males, 13 females) recruited from the community. The AD group was scanned within the first 24 hours of detoxification, and again after two weeks of supervised abstinence. Their scans were compared with those of the controls.

"We found evidence for a rather rapid recovery of the brain from alcohol induced volume loss within the initial 14 days of abstinence," said Ende. "Although brain shrinkage as well as a partial recovery with continued abstinence have been elaborately described in previous studies, no previous study has looked at the brain immediately at the onset of alcohol withdrawal and short term recovery. Our study

corroborates previous findings of brain volume reduction for certain brain regions."

The findings also showed a volume reduction of the cerebellum at the time of detoxification. "This has rarely been observed in other studies at later time points after alcohol withdrawal," said Ende. "Two weeks after detoxification, this cerebellum reduction was nearly completely ameliorated. This was unknown previously, the amount of initial reduction in the cerebellum and its relatively fast recovery."

Ende added that an individual's ability to recover from AD appears to vary for different brain regions. "The function of the cerebellum is motor coordination and fine tuning of motor skills," she explained. "Even though we did not access the amelioration of motor deficits in our patients quantitatively, it is striking that there is an obvious improvement of motor skills soon after cessation of drinking, which is paralleled by our observation of a rapid volume recovery of the cerebellum. Higher cognitive functions like divided attention, which are processed in specific cortical areas, take a longer time to recover and this seems to be mirrored in the observed slower recovery of brain volumes of these areas."

"Many alcohol treatment programs only deal with the withdrawal stage of abstinence from alcohol, that is, the first three days," noted Zahr. "Based on the current study and others, suggesting that a minimum set of cognitive abilities is necessary to conquer alcohol addiction, clinicians should consider recovery programs that provide support for the recovering addict for a minimum of two weeks."

Ende agreed. "The ultimate goal of alcoholism treatment is the maintenance of abstinence," she said. "To achieve this, the affected person needs to suppress their drinking urges and relearn to value other pleasures. Brain volume loss hinders this difficult process, so a rapid

volume gain is advantageous for the establishment of sober relearning."

"This study offers recovering alcoholics a sense of hope," said Zahr. "Hope that even within two weeks of abstinence, the recovering individual should be able to observe improvements in brain functioning that may allow for better insight and thus ability to remain sober. Indeed, a minimal of brain healing may be necessary before the addict is able to achieve the control necessary to maintain continued abstinence."

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