

Alcohol's frontal-lobe damage may become evident before general mental status is challenged

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Frontal lobe deficiency, characterized by executive dysfunction such as deficits in attention and working memory, has been linked with an inability to abstain from alcohol. However, "high-functioning" alcoholics with frontal executive dysfunction may nonetheless appear to have a "normal" cognitive mental status. Findings from a new study using magnetic resonance imaging (MRI) to examine volumetric measurements of segmented brain structures suggest that executive function and general mental status are affected differently by long-term use of alcohol.

Results will be published in the April 2014 online-only issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"An individual with [executive dysfunction](#) may not be able to anticipate and plan for the future, making the associated decisions," explained Ester M. Nakamura-Palacios, associate professor and senior scientist at the Federal University of Espírito Santo in Brazil as well as corresponding author for the study. "They may be unable to solve problems, even simple ones, and have difficulties focusing their attention or concentrating on something. They may get stuck in one response or one thought, showing inflexible behavior or thinking, or be unable to change their response when facing a new situation demanding a new or different direction. Notably, they may have difficulties

controlling their own behavior, losing the ability to inhibit inadequate or even injurious behaviors."

"For many people, but especially for those who investigate the brain and its functioning, the frontal lobes are those structures that represent best the nature of humanity," said J. Leon Morales-Quezada, a research associate in the Neuromodulation Laboratory at Harvard Medical School. "These lobes located in the front of the whole brain are the governors of our behavior and are responsible for the acts that separate the homo 'thinker' sapiens from the rest of the animal kingdom. The frontal lobes control and inhibit our primal impulses; this inhibition of such impulses prevents us from taking dangerous risks, or behaving in a deviant way, and facilitates our living as a community."

"An alcoholic who is a highly skilled professional, for example, an engineer or professor, may be perfectly able to perform regular duties such as temporal and spatial orientation, naming things, and calculations. However, this highly skilled person may be frontally impaired and unable to change or control their use of [alcohol](#) or drugs, even knowing that this behavior was and is harmful, or make important decisions in urgent situations. Imagine this highly skilled alcoholic subject driving on a road and a soccer ball unexpectedly crosses in front of his or her car, likely followed by a child. Most of us would bring together all faculties needed to evaluate the situation, the possible consequences, and quickly take action, even if you hurt yourself. What if someone is unable to execute these functions in a proper way?"

Nakamura-Palacios and her colleagues examined 60 alcoholic subjects (52 males, 8 females) with a mean age of 47.2 years who were identified as heavy, long-term drinkers. All participants were given the Frontal Assessment Battery (FAB) and the Mini-Mental State Examination (MMSE) as well as an MRI. In addition, cortical and subcortical segmentation and corrections were performed. Multiple linear

regressions analyses were then conducted, utilizing volumetric measures of segmented brain structures as predictors for FAB or MMSE scores.

"We found that structural changes in specific prefrontal area along with the cerebellum in the left side of the brain can predict executive performance in alcoholics," said Nakamura-Palacios. "Thus, we suspect that, depending on the volumes of dorsolateral prefrontal cortex and cerebellum, an alcohol user may present executive dysfunctions even when clinical signs of alcohol dependence are absent or mild and their more global mental status is still preserved. This may help to provide a more precocious diagnosis of drug addiction and earlier health assistance."

"The correlation found between the FAB and the changes observed in the left frontal and cerebellar areas is an important finding," added Morales-Quezada, "because it predicts how an anatomical abnormality can represent a functional deficit even when mental functions appear 'normal.' These results also give us insight into how differently the brain operates and reorganizes after an insult, in this case, a toxic insult. While essential functions such as the [mental-status](#) ones evaluated can be preserved due to inner cognitive reserve and hard-wire consolidation, the higher, more sophisticated networks can be targeted by a toxic assault of chronic alcohol consumption. It seems that the brain will sacrifice first the networks that cannot be sustained because of the high cost of their retention; this is true when metabolism is limited or a persistent damage is on the rise."

"Frontal impairment is a hallmark in alcoholism and also in other drug addictions," said Nakamura-Palacios, "yet many gaps still remain regarding our understanding of this disorder. The consequences of alcohol and drug use among youth are especially worrisome as they occur during a time when the prefrontal cortex is still maturing. Behavioral changes may not be seen when they are still young but they

become more apparent in adult age, when they are required to take responsibilities for many aspects of their lives. Unfortunately, we are still making late diagnoses, especially for alcoholism, when these structural brain changes are already established."

"Perhaps this research will help relatives of those suffering from this condition to better understand some of the problems they see, especially how difficult is for an alcoholic to control his/her impulses towards alcohol or their behaviors affecting other people," said Morales-Quezada. "Alcohol represents physical damage to the brain and a direct attack on its functions; the chronic toxicity of alcohol leads to aberrant behaviors that perpetuate the entrapped cycle of an addiction."

Provided by Alcoholism: Clinical & Experimental Research

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