Reduced Cortical Thickness in Abstinent Alcoholics and Association with Alcoholic Behavior

Alcoholism, Clinical and Experimental Research; December 2011

Major Findings: Even among those who are now abstinent, widespread reductions in cortical brain thickness were observed as a consequence of chronic alcoholism. The most severe reductions occurred in frontal and temporal brain regions. Decreased cortical thickness among members in the alcoholic group was associated with their severity of alcohol abuse.

Of interest To: Patients with alcohol dependence disorders and family members; treatment providers and policy makers in substance use disorders.

Background: Chronic misuse of alcohol results in morphological damages to the brain, as revealed with post-mortem analyses and in vivo neuroimaging techniques. Abundant evidence from these different methodologies indicates that the effects of alcohol are widespread and include neuronal degeneration of the cerebral cortex, cerebellum, and brainstem, as well as changes in the white matter underlying the cerebral cortex. The impact of alcohol on the cerebral cortex, and in particular the frontal lobes, has received considerable attention for decades. Although various methods of image analysis have been employed to estimate focal structural damage related to alcohol abuse, none have examined alcohol-associated atrophy using cortical thickness measurements to obtain a regional mapping of tissue loss across the full cortical surface.

Procedures: The research team compared cortical thickness measures by obtaining high resolution structural MR scans from 65 study participants examined at the VA Boston Healthcare System. Participants were divided into two groups: abstinent individuals with a history of prior alcohol abuse (n=31) and healthy nonalcoholic control participants (n=34). Cortical surface models were created from high-resolution T1-weighted images and cortical thickness was then estimated as the distance between the gray matter/white matter boundary and the outer cortical surface.

Findings: Community dwelling abstinent alcoholics showed reduced whole brain thickness as compared to nonalcoholic participants. Decreases in thickness were found bilaterally in (1) superior frontal, (2) pre-central, (3) post-central, (4) middle frontal, (5) middle/superior temporal, (6) middle temporal, and (7) lateral occipital cortical regions. Decreased cortical thickness in the alcoholic group was associated with severity of alcohol abuse. Interestingly, successful abstinence from alcohol was associated with increased cortical thickness for individuals in their first decade of sobriety. Although results require confirmation with a longitudinal design, researchers point out that their findings support the notion that the brain may recover tissue integrity and function with maintained abstinence, particularly during the initial 2 years of sobriety.
**Figure:** Significance maps of the group differences in cortical thickness in the abstinent alcoholics as compared to nonalcoholic control participants. Areas of significance were noted using light blue (p=.01) and dark blue (p=.05), indicating significantly decreased cortical thickness in the alcoholic individuals as compared to nonalcoholic control participants. The clusterwise analysis revealed areas of significant difference between groups remained after multiple comparison corrections procedures.

**Limitations:** Although the approach is a very sensitive and accurate way of measuring neuropathology *in vivo*, there are other brain structures the researchers did not investigate but are nonetheless impacted by alcohol, most importantly, the cerebellum. The cerebellum is in fact the primary neurologic target of alcohol’s deleterious effects. The team continues to develop its ability to assess volume, cortex, and white matter in the cerebellum and hopes to address the association between cerebellar integrity and alcohol consumption in future investigations. It should be stressed that the current findings were derived using a whole-brain analysis that yielded regions of greatest significance, rather than an *a priori* region-by-region comparison that can be susceptible to variations in the statistical sensitivity of each isolated region/comparison. This approach has advantages in detecting regionally specific cortical atrophy associated with subtle brain changes without being limited by regional hypotheses. Future investigations should continue to quantify cortical thickness alterations related to alcohol and to relate cortical thickness to severity of alcoholism. Particularly, cortical thickness should be related to measures of alcohol consumption across a variety of drinkers to investigate if quantity of alcohol consumed can predict brain changes. Further, relationships between cognitive dysfunction and cortical thickness measures in alcoholics should be explored.

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