Study shows that people most affected by alcohol also most impacted by sleep deprivation

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A team of researchers from the German Aerospace Center and Forschungszentrum Jülich has found that people who are most susceptible to alcohol intoxication are also most susceptible to cognitive

problems due to sleep deprivation. In their paper published in *Proceedings of the National Academy of Sciences*, the group describes testing volunteers with vodka and sleep deprivation and what they found.

Most everyone knows that drinking alcoholic beverages can cause cognitive problems. In a similar vein, most people understand that they are not able to think as well when they are having sleep problems. In this new effort, the researchers sought to discover if there was a correlation between the two.

To learn more about how drinking and poor sleep impacts people, the researchers enlisted the assistance of 49 volunteers, each of whom were given quantities of vodka to drink. The amount differed depending on the weight of the volunteer. Each was given the equivalent of five double vodkas for an average-sized person. Each volunteer then had their cognitive abilities tested using standard testing mechanisms such as sustained attention and time-to-react tests. Later, each of the volunteers underwent sleep deprivation—some were allowed to sleep for just five hours a night for four nights, while others were prevented from sleeping altogether for 38 hours straight. Each was then given the same types of cognitive tests.

In comparing the results, the researchers found that those individuals who performed the worst on cognitive tests after drinking also did the worst on tests given to them after sleep deprivation. They also found that there was a large difference in impact on the volunteers. Those who were most impacted by sleep deprivation saw their cognitive abilities decline dramatically—taking twice as much time to react, for example. Comparatively, those who saw the least impact were just 17 percent slower.

Ten volunteers underwent PET scans after drinking alcohol. The

researchers report that the volunteers experienced an increase in cerebral A1 adenosine receptor activity in multiple parts of the brain, which, they note, was similar to changes seen for sleep deprived people in prior studies.

More information: Eva-Maria Elmenhorst et al. Cognitive impairments by alcohol and sleep deprivation indicate trait characteristics and a potential role for adenosine A1receptors, *Proceedings of the National Academy of Sciences* (2018). DOI: 10.1073/pnas.1803770115

Abstract

Trait-like differences in cognitive performance after sleep loss put some individuals more at risk than others, the basis of such disparities remaining largely unknown. Similarly, interindividual differences in impairment in response to alcohol intake have been observed. We tested whether performance impairments due to either acute or chronic sleep loss can be predicted by an individual's vulnerability to acute alcohol intake. Also, we used positron emission tomography (PET) to test whether acute alcohol infusion results in an up-regulation of cerebral A1 adenosine receptors (A1ARs), similar to the changes previously observed following sleep deprivation. Sustained attention in the psychomotor vigilance task (PVT) was tested in 49 healthy volunteers (26 ± 5 SD years; 15 females) (i) under baseline conditions: (ii) after ethanol intake, and after either (iii) total sleep deprivation (TSD; 35 hours awake; n = 35) or (iv) partial sleep deprivation (PSD; four nights with 5 hours scheduled sleep; n = 14). Ethanol- versus placebo-induced changes in cerebral A1AR availability were measured in 10 healthy male volunteers (31 ± 9 years) with [18F]8-cyclopentyl-3-(3-fluoropropyl)-1-propylxanthine (CPFPX) PET. Highly significant correlations between the performance impairments induced by ethanol and sleep deprivation were found for various PVT parameters, including mean speed (TSD, r = 0.62; PSD, r = 0.84). A1AR

availability increased up to 26% in several brain regions with ethanol infusion. Our studies revealed individual trait characteristics for being either vulnerable or resilient to both alcohol and to sleep deprivation. Both interventions induce gradual increases in cerebral A1AR availability, pointing to a potential common molecular response mechanism.