An energy dense diet changes the brain and increases urge to eat

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Research by Stephanie Borgland at the University of Calgary shows that giving rats unrestricted access to unhealthy foods for extended periods not only leads to obesity, but also to brain changes that makes food more attractive to them, even when their hunger should be satisfied. Specifically, Dr. Borgland's research identified modifications in endocannabinoid signalling in a brain region called the orbitofrontal cortex (OFC) of these obese rats. These unpublished results were presented at the 2018 Canadian Neuroscience Meeting, in Vancouver, May 15th, 2018.

The "cafeteria diet" is a model for feeding in which rats have, in addition to their regular balanced diet (or "rat chow"), access to an unlimited amount of high-fat, high-sugar foods, including chocolate and other treats. In Dr. Borgland's study, rats became obese after 40 days of 24h/day access to cafeteria diet, while rats with limited access (1h per day) did not. Previous work done in Dr. Borgland's laboratory had shown modification in signaling in a brain region called the Orbitofrontal Cortex (OFC) in obese rats, and this study aimed to better understand these modifications.

The OFC is a brain region located at the surface of the brain, above the orbits of the eyes. This brain region is involved in decision-making and receives information about food from the senses (taste, touch and smell) to register the value of food, and updates feeding behaviour based on this information. In non-obese animals, satiety following eating leads to food devaluation, and a reduced motivation to eat.

In obese animals however, previous work in the Borgland lab had shown a reduction in the inhibitory (or "stop") signals on a class of neurons called pyramidal neurons in the OFC. This study identified endocannabinoid signaling as a key player in this modification.

"Obesity is typically associated with an elevated level of endocannabinoids in both humans and rodents, so these results are not surprising.

However, endocannabinoid signaling is much more complex than previously thought. Our research shows that endocannabinoid signaling selectively affect inhibitory signals onto the pyramidal neurons of the OFC. This effect is mediated through changes in specific receptors on the neurons, but may also involve other types of cells in the brain, called astrocytes." Says Stephanie Borgland.

The world health organization indicates that obesity has nearly tripled since 1975, and estimates that 13% of adults in the world were obese in 2016. Obesity is a major risk factor for cardiovascular disease, such as heart disease and stroke, disorders such as osteoarthritis and some cancers.

"Future studies will need to further investigate the mechanisms through which endocannabinoids affect the motivation to eat beyond satiety. This will be critical in identifying novel therapeutic strategies for treating obesity with fewer side effects" concludes Dr. Borgland.

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