Hormone regulates fondness for food

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Scientists have discovered that leptin, one of the key hormones responsible for reducing hunger and increasing the feeling of fullness, also controls our fondness for food.

A University of Cambridge team, headed by Dr Sadaf Farooqi and Dr Paul Fletcher, have discovered that the appetising properties of food have strong effects on the same key brain regions responsible for rewarding emotions and desires. Using brain imaging technology, they show that these areas of the brain “light up” when individuals deficient in leptin are shown images of food.

Hunger influences what and how much we eat, but is not the only determinant of our eating behaviour. Eating is a very pleasant experience and the rewarding or appetising properties of food play a major role and can lead to overeating when they over-ride the biological cues that govern hunger and fullness.

Understanding eating behaviour therefore means that we must take into account physiological and hormonal pathways and also the brain processes evoked by the sight, smell, taste, or even just the thought, of food. More challenging still is to develop an understanding of the ways in which these two sets of processes – the physiological and the brain/neural – interact to shape our patterns of eating.

The authors sought to find a connection between the pathways in the brain that know when you are hungry or full and the parts of the brain that are involved in how much you desire and enjoy food. They

postulated that leptin, one of the major hormones controlling weight, might be the key.

The hormone leptin is made by fat cells and circulates in the bloodstream to reach the brain where it acts to reduce hunger and increase fullness. The authors studied patients with a rare genetic disorder resulting in a complete lack of leptin. These patients eat excessively, like all types of food (including really bland foods) and develop severe obesity. After treatment with leptin, their hunger is reduced, they become more choosey about food and they lose weight.

In this study, funded by the MRC and the Wellcome Trust, the patients were asked to look at a series of pictures while brain activity was recorded using Functional Magnetic Resonance Imaging (fMRI for short)). The fMRI scanner shows which parts of the brain are activated or “light up” in response to different pictures. The pattern of brain activation in response to pictures of food was compared to that seen with pictures of non-food items such as trees, cars, and boats. Some of the foods were really appetising (chocolate cake, strawberries, pizza) while others were rather bland (cauliflower, broccoli).

The authors showed that in the patients lacking leptin, several areas of the brain - known collectively as striatal regions - respond to pictures of food. These areas have previously been linked to pleasant and rewarding emotions and desires. When the patients were treated with leptin, responses to food pictures in these areas were reduced.

One of the striatal regions - the nucleus accumbens - was especially responsive to pictures of foods that people find more appetising. For example, its activity was higher in response to a picture of chocolate cake than to a picture of broccoli. In healthy volunteers, activation of the nucleus accumbens by appetising foods was only found when the person was hungry (following an overnight fast).

In the leptin deficient patients, the nucleus accumbens showed this distinctive response (greater for well-liked foods) when patients were hungry (following an overnight fast) but also after they'd just eaten. After treatment with leptin, the response in these patients normalised so that the nucleus accumbens was activated predominantly by foods they liked and only when they had had nothing to eat overnight and were hungry.

Taken together, these findings have important implications for the understanding of how two key systems - the pathways that control hunger and fullness and the brain processes involved in liking and wanting foods - may interact. The scientists determined that hunger clearly has an impact on activation in striatal regions of the brain in response to food pictures and consumption of food modifies these responses. This modification requires the hormone leptin since, when it is lacking, these brain regions remain very sensitive to the presence and type of food pictures even following a meal.

Dr Farooqi, University Department of Clinical Biochemistry, says: "While body weight remains stable for many people over a long period of time, other people gain weight very easily. More studies are needed to find out how these brain responses vary in people with weight problems in general. Research is needed to find out how leptin triggers other chemicals in the brain and how alteration of these pathways contributes to overeating and obesity.

"Understanding how brain systems interact with hormones that signal hunger and energy stores will provide us with a more complete picture of factors controlling eating behaviour and will hopefully take us beyond some of the prevailing and simplistic assumptions about why some people have difficulties in controlling how much they eat.

"Such understanding will be a key step in the prevention and treatment

of obesity. Importantly, the finding that the liking of food is biologically driven should encourage a more sympathetic attitude to people with weight problems."

Source: University of Cambridge