

# Does Obesity Need Brain Surgery?

*The human brain holds many of the secrets to why people react differently to the lure of food. By way of using brain-imaging technology, scientists have been able to pinpoint how the brain reacts.*

by Henk W. Hoogenkamp

The number of overweight and obese people has tripled since 1990 and it is estimated that 10 percent of the total national healthcare budget is spent on the treatment of obesity related diseases. It is further estimated that about one third of the avoidable disease burden can be attributed to an unhealthy diet. If America is an example for food related diseases, it doesn't look good for the rest of the world, which usually follows the American lead with a time-lag of some 10 to 15 years.

Americans are continuing to get fatter and fatter with obesity rates reaching 30 percent of the population in more than nine States in 2010, as opposed to only three States in 2007. These increases mean that 2.7 million more people became obese from 2007 to 2010, bringing

the total to almost 73 million; a staggering 27 percent of the entire population. If nothing changes significantly in the environment and culture of the US, about 42 percent of adults will be obese by 2050.

## Troubling Trends

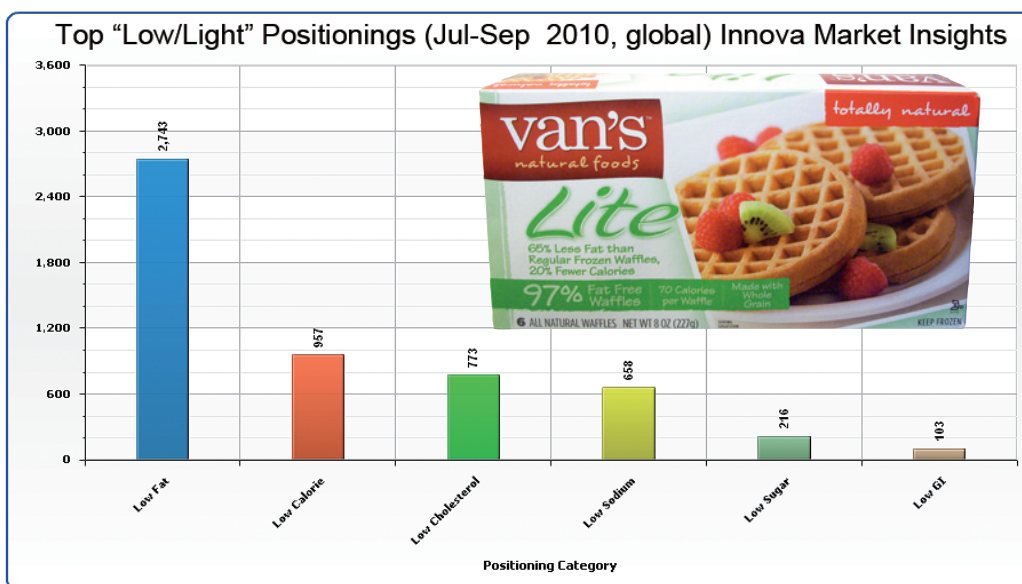
Within the demographic segments of the obesity epidemic, there are troubling trends like malnourished elderly people who do not meet their special nutrient needs and early puberty in girls that can develop into major social consequences. Obviously, food choices and health consequences are not in balance. Of course it is a known fact that food choice and eating patterns are strongly influenced by the social environment and that these findings can be extrapolated to psychological, metabolic, molecular and brain

mechanisms research within the body in its relation to the intake of food. In general it can be concluded that obese people have low self-esteem and can rapidly develop into societal issues. Although it is true that healthy eating is a choice all people in the developed world can freely make, it is too simple to conclude that obesity is only a matter of more calories in than out, because preventing weight gain is not always in tandem with the factors that improve weight loss. For example, food satiation has seen major changes over the last decades, and the continuing growth of processed food consumption might also be a variable not to be underestimated. That is because processed foods are often energy-dense, easy to chew, and instantly provide the human body with calorie-overload.

In short: very often, processed foods lack the ability to satiate. To top it off: processed foods are mainly consumed away from home where and when food choices are often determined on instant satisfaction, gratification, and convenience. Moreover, food preferences are generally developed early in life and the aversion of plant foods or vegetables and fruits, is mainly caused by the low energy content. Within all these variables, the special roles of dietary fibers need to be mentioned. It is a known fact that dietary fibers are involved in metabolism, including such processes as increasing bulk weight and viscosity in the stomach and thus promoting satiety. There are a great many different types of dietary fibers and their mechanism of increased satiety depends on the specific properties on the physiological, metabolic and molecular effects. For example, it is a known fact that gut fermentation prolongs satiety and as such fibers can regulate gastric emptying and a higher gut transit time, resulting in a lower glycemic index.

## Diabetes Risk

Obesity rates have increased four-fold among children in the past 40 years. Factors explaining these surges are the steeply increased consumption of high-calorie foods and drinks and less physical activity during and after school. Cardiovascular conditions associated with obesity, such as high blood pressure and high blood cholesterol, are



increasingly being diagnosed during childhood, as is Type-2 diabetes. A new case of T2 diabetes is identified globally every 5 seconds, which translates into some 7 million new cases each year. People who regularly eat whole grains tend to have less visceral adipose tissue (VAT) – or fat around the abdominal organs – and thus less association with the higher risk of metabolic syndrome, a condition associated by obesity, hypertension and disturbed glucose and insulin metabolism. Most probably, a high intake of refined grains can cancel out the effect of whole grain and thus it is recommended to make dietary substitutions rather than simply adding whole grain foods.

Important is a drastic reduction in high-glycemic index (GI) foods. GI ranks food according to the speed that they metabolize into blood sugar. Hyper-refined carbs such as sugar, sweetened foods, and sugary beverages and baked goods made with white

flour, have the highest GI scores. Subsequently all these foods break down into glucose very rapidly and spike blood sugar levels quickly. In other words, consumption of foods high on the GI, not obesity itself, is the real culprit for T2 diabetes.

Most of the developed world has become a society of “carboholics” and that is probably the real cause of T2 diabetes epidemic. Losing weight is not the sole solution of avoiding T2 diabetes. Equally, or perhaps more important is a drastic reduction in high GI-foods.

### Regulating Hormones

At least 100 different hormones are associated with fat metabolism. Of these, adiponectin and leptin are the most known and studied and they regulate food intake and appetite respectively. The early-stage fat cells are among the largest and longest-living cells in the body, capable of expanding at least 64 times their original size. To put

this into perspective: a lean adult has some 40 billion fat cells, while an obese person can have about 120 billion.

It is important to know that all body fat is not equal. Basically there are subcutaneous fat cells stored under the skin like lower belly, hips, legs, and visceral fat cells that accumulate in and around organs like the heart and liver. Visceral fat can be released into the bloodstream, raising the risk for heart disease, stroke, diabetes, and Alzheimer’s disease. On the contrary, subcutaneous fat may be unsightly and not appeal to a person’s body image; they are relatively benign. Actually, in a body that works properly, subcutaneous fat pulls excess fat out of the bloodstream and stores it in big droplets – one per cell – until the body takes it back for energy expenditure. This mechanism is attuned to work effortlessly, though factors such as heredity and compulsive overeating can play havoc and distort the self-

regulating mechanisms. Then there are also the life-stages of the body to consider. People tend to gain subcutaneous fat through middle age, followed by a gradual decline in parts such as the back of the hands, lower legs, and neck. Instead it may reappear and pile up as visceral fat in muscle, liver and even bone marrow. Come to think of it, paradoxically speaking, losing subcutaneous fat is not all that good for the body. Fat that is not properly stored and protected in fat cells can be very toxic. Free-floating fat in the body, including the bloodstream, has the danger that it will trigger a lowering of leptin levels, signaling the brain to eat more.

### Brain Imaging

The human brain holds many of the secrets to why people react differently when they think or look at food. By ways of using brain-imaging technology, scientists have been able to pinpoint how the brain reacts to

the lure of food. Basically there are two brain responses to food: eating for survival or homeostatic and eating for pleasure or hedonic. In principle, the hormone leptin signals the brain to stop eating, but in obese people the brain no longer responds to these signals. Furthermore, brain scans show that obese people have stronger reactions to images of food than non-obese people. In everyday life, people are confronted with food by seeing, smelling and even hearing. Certain parts of the brain's memory subsequently can trigger the release of dopamine, the brain's pleasure chemical.

And it is exactly here where the discrepancy lies between homeostatic eaters who have the discipline to say "No," and the hedonic eaters who cannot resist the body's built-in mechanism that regulates hunger and say "Yes." The latter group is far more likely to be or become obese. Especially "hedonic" eaters seem to have a stronger response in what brain scientists define as the ventral tegmental area (VTA), the tiny spot in the brain where dopamine hormone is released. The overriding question that needs answering, however, is if the observation is due to response or cause. As

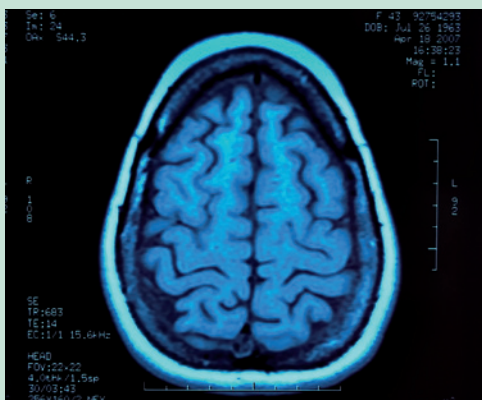
such obese people look at food as a reward influenced by emotion, attention, memory, rather than to stave off hunger.

### Response Interference

A calorie-laden diet of sweet and high-fat foods can blunt the body's built-in fullness signals and interfere with proper responses by hypothalamus, telling the body to stop eating. Leptin should act as a defense against overeating and in normal-weight people this mechanism works properly. However, most of the obese people release an overabundance of leptin and the brain simply ignore the sig-

nals. The verdict is still out, because while delicious food stimulates the release of dopamine in obese people, they actually have fewer dopamine receptors than normal weight people. Or to put it differently, obese people may actually find less enjoyment in eating sinfully delicious foods, triggering a desire to eat even more. Neurologically speaking, the triggering causes are pretty much similar for obesity as they are for anorexia, where the normal balance is disrupted. That probably explains the intriguing brain scan studies of people who have lost significant amounts of body weight and are successful in maintaining the lower body weight through diet and exercise. A very rare find, because most dieters return to "normal" overweight and obese proportions within a few months. It seems that suppressing pleasure is the hardest thing to do!

## Are There Neurosurgical Solutions to Obesity?



The problem of obesity is multi-factorial, with economic, socio-cultural, psychological and biological factors all playing a role. The definition of obesity is also a gray area i.e. what can be considered in the normal range and what defines a true illness? On a large scale, the problem of overweight can be tackled by means of educational programs starting at young age, for example in kindergarten. The possible individual solutions may lie in behavioral/psychological/dietary management or medical therapies.

Medically, the treatment can be offered by pharmacological means. Surgical treatment

has been shown to be effective, but with a cost. Bariatric surgery, in which stomach size is altered or in which parts of the gastro-intestinal tract are removed, has its risks. These risks are not confined to the operation itself. Long term effects are also documented and include poorer uptake of essential nutrients. These can lead to other medical or neurological deficits, which may be irreversible. Another surgical approach might be brain surgery. Indeed, as all human behavior and responses are governed by the brain, the pathological food intake of a morbid obese patient may be targeted by modulating the brain.

Neuroscience has elucidated part of the brain mechanisms that are involved in hunger, thirst and satiety. Neurosurgical treatment of psychiatric diseases like depression and obsessive-compulsive disorder have been shown to be safe and reliable. In the same vein, there is clinical research on the treatment of anorexia nervosa by brain surgery, i.e. neuromodulation. Could it also be done for (morbid) obesity? By implanting electrodes in the brain, some aberrant behavior or emotions and cognition can be modulated. For diseases like depression and obsessive compulsive disorder this has been shown to be effective. For diseases like anorexia nervosa this is currently under investigation. Of course, obesity might be another disease which can be treated by implanting brain electrodes. The current state of our scientific knowledge suggests that it might indeed require an extra mode of treatment. For brain surgery to become a mainstream treatment option for obesity however, it should be meticulously studied and compared to current (medical and surgical) treatment modalities. Some leading academic centers are currently investigating the possibility of the implementation of this type of surgery. In a few years, the first real clinical experiences will be known. The results of research notwithstanding, the question of whether "Does Obesity Need Brain Surgery" is and will be an ethical one.

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### Blurring Snack Lines

Although fast food companies like McDonald's are committed to providing balanced menu choices and a variety of options to meet consumers' needs and preferences, they epitomize fast food and the permeation of fast food. The mind-set of people who walk into a burger-chain is not healthy eating; it is about giving in to basic human instincts and the desire to enjoy and indulge in flavor, taste and aroma sensations. Of course, there are more variables at play. The traditional demarcation lines between breakfast, lunch and dinner is rapidly changing. Do people see a chicken sandwich as a meal or as a snack?

These lines are becoming increasingly blurry and fast food companies are launching a host of new snack foods that were considered a full meal only a few years ago. Besides the fact that people growing even shorter on time, demographics and value also play an important role. Younger consumers are more likely to define almost

any food as a snack, while snack-value and snack-habit perform much better during a recession or economic downturn than full meals. Snack foods usually provide a quick energy boost because most ready-made carb-based snacks are loaded with white flour and/or sugar. These carbs trigger the release of the serotonin hormone and even provide a brief mood lift. It can be expected that to meet dietary guidelines, snack foods will be reformulated to pair it with more complex fiber/protein ingredients – such as rice bran – to blunt blood-sugar spikes. Eating more protein and fiber is one of the secrets to stabilizing blood sugar and losing weight.

### Social Obesity

Healthy eating and physical activity may be the way forward to prevent many problems later in life. Perhaps it is too early to conclude that there is a link between food and early onset

of puberty of girls. Much of the information is empirical, but while the causes of this trend are still unknown, one chief culprit is believed to be early obesity. There is a hypothesis that excess body fat stimulates the production of estrogen, which in turn triggers breast development and menstruation. Another hypothesis points at endocrine-disrupting chemicals in the environment – such as Bisphenol-A. This is present in many plastic products such as baby feeding bottles, and simple things such as water bottles and other food containers. The European Union recently announced that it was banning baby bottles containing Bisphenol-A as of early 2011, over fears it may harm the health of children.

### Behavioral Worries

Diets that are high in junk food have also been linked to an increased risk of behavioral and emotional problems for

children, with a greater risk of Attention Deficit Hyperactivity Disorder (ADHD). There is a significant relationship between what children eat and their brain function.

Children's diets can basically be classified into two eating styles – a “healthy” pattern high in fresh vegetables and fruit, whole grain and moderate amounts of meat and fish and a “Western” diet higher in saturated fat, refined sugary foods, salt, confectionery, ready-to-eat meals, and hyper-processed and fried foods. Perhaps the question is not what children are eating, but rather what they are not eating. What is most notably missing from highly processed foods – and perhaps crucially for brain health – are omega 3 fats and B vitamins, including folate. These micronutrients are especially found in legumes, leafy green vegetables, whole grain foods, nuts and fruits. Omega 3 fats are an essential part of the

nervous system and the theory is that when not enough in the diet, brain functions are affected.

Not only adults, but especially children need nutrient-dense foods. As such, white bread should be avoided, for example, because it is high in carbohydrates but low in nutrients, including B vitamins. Fruits and vegetables have been shown to protect brain health because of the presence of antioxidants such as C+E vitamins. These vitamins are linked to preventing inflammation and perhaps also depression. Feeling depressed or emotionally distressed can lead to binge drinking or eating sweet carb-rich and or fatty foods. Now that obesity is a common sight, it is postulate that depression will increase. The question however is, which comes first: depression or obesity? ♦

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