Sugar, Fat and Brain Function

The Big Question: Sugar or Fat

It’s been called ‘the hottest question in nutrition’. Which is worse for you, sugar or fat? Butter and cream, or ‘low-fat’ (high-sugar) yoghurt? Many people are concerned about obesity, for health as well as for cosmetic reasons. Yet, even though brains don’t store sugar and fat the way bodies do, what you eat has a big impact on your brain.

Brains need lots of energy. At rest a quarter of the body’s total energy consumption is by the brain. Most of this is normally provided by glucose derived from starch or sugar (which is rare in the wild). Although fats have twice the energy content of glucose they need to be broken down to ketones before they can get into the brain. This only occurs to a major extent during starvation when stored fat is broken down to ketone bodies and can substitute for glucose. So on the face of it dietary sugar should be better for the brain, and large changes in blood glucose concentration (hyper- or hypo-glycaemia) can cause apathy, depression, confusion, even unconsciousness. But modern diets tend to contain too much of both sugar and fat. So the more pertinent question that some ask is ‘which in excess is the more harmful?’

Sugar and the Brain

Blood levels of glucose are controlled by two hormones released by the pancreas: insulin which lowers them, and glucagon which raises them. They are also controlled by glucose-sensitive nerve cells in the hypothalamus that control your feelings of hunger or satiety associated with the release of key hormones into the bloodstream by the pituitary gland, e.g. growth hormone, stress and sex steroids; these modulate blood glucose and fat levels. Blood levels of fats are also affected by insulin which reduces fat levels by increasing fat storage. So excessive sugar intake is converted into body-fat.

Sugar (sucrose) is actually made of two molecules, glucose and fructose. The body has far less control over blood fructose levels. Excess glucose is diverted into glycogen stored in liver and muscle or converted into stored fat, but fructose bypasses the main glucose control point and, particularly in the liver, may be converted into fat that stays there and can damage it.

Worse, long-term over-consumption of sugar weakens all the regulatory mechanisms, often leading to insulin resistance, hyperglycaemia and greater risk of diabetes, fatty liver, heart disease and neurodegeneration. Hyperglycaemia can also damage the platelets which help blood to clot, worsening the damage after haemorrhagic strokes (brain bleeding).

Fat and the Brain

Brains also need certain fats, however, as their cell membranes are made of it, but the type of fat is very important. Unlike saturated fats whose main function is to supply energy, polyunsaturated fats (especially omega-3s) are vital components of cell membranes; they keep them flexible, allowing the proteins embedded in them more freedom to change shape. These proteins include the receptors which react to neurotransmitter signals, and these changes in shape are what trigger the nerve impulses that communicate from one nerve cell to the next. Neurons are superbly specialised for such fast, efficient transmission, but they evolved before today’s diet of high levels of saturated fat.

Excess saturated fat together with omega-6 unsaturated fats may also affect the brain’s vital blood supply by contributing to hardening of the arteries, in which fatty deposits clog up blood vessels. This raises the risk of an ischaemic stroke, where a blockage cuts off supplies to part of the brain, rapidly destroying nearby neurons.

Sugar and Fat

The effects of sugar and fat come together in inflammation, because both stimulate fat deposition (fructose is especially potent). Fat cells release pro-inflammatory cytokines, chemicals which can damage brain cells and blood vessels. High-sugar and high-fat diets, furthermore, tend to lack beneficial micronutrients like the anti-inflammatory omega-3s. Recent research suggests that inflammation is important not only in diabetes and heart disease, but in brain diseases like stroke, vascular dementia and Alzheimer’s.

Which is worse for you, sugar or (saturated) fat? Science suggests it’s unwise to eat too much of either.