YORK *mind-body* HEALTH
Information Sheet
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Blood Sugar Control & Insulin Resistance

Introduction

Health depends upon the ability to maintain physiological equilibrium, and thus on the ability to self-regulate. Self-regulation means adjusting physiological parameters to maintain a healthy equilibrium, or sometimes to change the state of the body in order to meet the demands of some particular context. As an example of such a physiological parameter, consider blood pressure. Blood pressure needs to be sufficient to transport blood around the body but not so high as to cause wear and damage to blood vessels. There is thus a healthy range for resting blood pressure - but if you exercise vigorously your blood pressure will rise considerably higher, and this is a normal and healthy response.

Another physiological parameter that needs to be controlled for health is the blood glucose level.

Blood Sugar

Glucose is a type of sugar, and the main fuel for the cells in your body. Glucose, along with the oxygen required to burn it, is delivered to the cells by the blood.

If the blood glucose level drops to low, then the cells don't get enough energy to meet their needs. This state is called hypoglycaemia, and its main characteristic is tiredness or fatigue. Although many cells can also utilise protein and fats for energy, brain cells are dependent on glucose and thus the brain is particularly vulnerable to hypoglycaemia.

On the other hand, if blood glucose rises too high, it actually becomes toxic. Glucose starts reacting chemically with other functional molecules, such as DNA and proteins, rendering them useless - a process known as glycation. High blood glucose is called hyperglycaemia, and in diabetes it becomes chronic. Glycation is the reason why diabetes is such a dangerous condition.

So blood glucose needs to be maintained within bounds - not too high or too low. We control our blood glucose mainly via hormones but also via the nervous system (specifically the Autonomic Nervous System or ANS).

Hormonal Control of Blood Sugar

Hormones are signalling molecules released by the glands into the blood stream. Cells in other parts of the body then detect these molecules and adjust their functioning in response.

The body has several hormones that can raise blood glucose when it is too low, but only one can lower it - insulin. This is why insulin is so vital to health: because it doesn't really have a back-up, any problems with insulin lead to dangerous consequences.

Insulin is secreted by the pancreas, and it affects nearly all cells in the body. It instructs the cells to open their doors to glucose. Without insulin the glucose stays in the blood (leading to hyperglycaemia) while the cells are in danger of starving.

Hormones capable of raising blood sugar include glucagon (also secreted by the pancreas and a counterpart to insulin) but also the stress hormones, adrenalin and cortisol. The latter are secreted as part of the "fight or flight" response - mobilising sugar reserves is generally a useful anticipation of action in response to a perceived threat.

Insulin Secretion in Relation to Eating

Insulin is secreted by the pancreas when we eat. This is because food contains carbohydrates which are broken down by digestion into simple sugars (see the information sheet on carbohydrates). Glucose is one of the most common components of carbohydrate, so eating any carbohydrate will lead to a rise in blood glucose (the glucose is absorbed from the gut into the bloodstream).

How much insulin is released depends upon how much glucose enters the blood stream, but also on *how fast* in enters.

The Trouble with Eating Sugar and Refined Carbohydrate

If you consumed pure glucose it would very rapidly enter the blood stream since it doesn't need time to be digested or broken down. This causes the blood glucose level to rise too high, leading to a rapid rise in insulin. If you eat sugary foods such as cakes, sweets and biscuits, pretty much the same thing happens. If you eat foods composed mainly of refined carbohydrates, again you get a similar response, because refined carbohydrates are very easily and rapidly broken down into sugars. Refined carbohydrate foods include white bread, white pasta, white rice and many breakfast cereals such as corn flakes.

The surge of insulin triggered by this sugar rush typically leads to an over-compensation - the blood glucose level peaks then troughs. The low (typically occurring one or two hours after eating the sugary food) besides leaving you feeling tired, is usually a trigger for hunger and perhaps even craving.

The effect of a food on blood glucose and insulin is quantified as Glycaemic Load (GL) - the higher the GL the greater the peak in blood sugar and insulin. This concept is covered in more detail in the carbohydrates information sheet.

Weight Gain

Glucose that is not used immediately for energy is stored, in the first place as glycogen in the liver and muscles, but when these stores are full it is converted into fat. Peaks in blood sugar are likely to lead to greater fat deposition. Research bears this out. In one study, groups of rats were fed calorie-matched diets, but in one case quick-releasing calories (high GL) and in the other slow-releasing (low GL). The former group gained weight (they were 16% heavier after 32 weeks) while the low GL rats maintained a stable weight (1).

Eating a meal slowly is known to give a much steadier rise in blood glucose and therefore insulin. This is why eating slowly is a very useful piece of advice for weight loss (2).

Insulin Resistance

If such peaks and troughs in blood glucose caused by eating sugary foods are a regular occurrence over many years, you risk developing *insulin resistance*. In this condition, the cells don't respond to insulin as they should. It means that the pancreas has to work harder, secreting even more insulin to bring blood glucose back within bounds. Eventually you may reach the point where the pancreatic production of insulin is not sufficient. You now have type II diabetes (the definition of which is that your fasting blood glucose level exceeding a threshold). In other words, insulin resistance is a precursor stage for diabetes. In diabetes the pancreas may become exhausted and drop off its production of insulin.

Symptoms of Insulin Resistance

The major symptoms of insulin resistance are:

- Fatigue and tiredness, especially early morning and mid to late afternoon.
- Craving sugary foods or carbohydrates - this is often because not enough glucose is crossing cell membranes.
- Overweight (especially abdominal) or difficulty losing weight. Insulin inhibits fat cells from releasing fat into the blood.
- Excessive thirst. This is associated with high blood glucose levels.
- Prone to headaches
- Digestive problems such as bloating or IBS
- Dry skin or perhaps acne
- Inflammatory symptoms such as arthritis
- Need to eat frequently or not coping well with missed meals
- High blood pressure, and risk of other cardiovascular problems

Note that you don't have to have every symptom (or even most) to have insulin resistance.

Causes of Insulin Resistance

There are several causal factors for insulin resistance, not all of which need be present in any individual.

Poor diet is perhaps the main factor, in particular consuming too much refined carbohydrates and sugars, but others include insufficient protein, and deficiencies in specific nutrients such as chromium and magnesium.

Being overweight is a major factor - fat cells (adipocytes) become swollen and overloaded so it is difficult for them to convert more glucose into fat.

Stress is a factor, and in particular chronically high levels of the stress hormone cortisol. Cortisol, like many hormones, is designed for occasional use only - when it is chronically high it causes damage. Chronically high cortisol and insulin present contradictory messages - on the one hand raise blood sugar and on the other, lower it. It's not surprising this causes problems with the body's control systems.

Systemic inflammation also contributes to insulin resistance. Systemic inflammation can be caused by poor gut health, allergies and food intolerances, poor detoxification and oxidative stress. (The topic of inflammation is covered in another information sheet.)

Other causes include lifestyle factors such as sedentary lifestyle, smoking, overuse of stimulants such as caffeine which raise blood glucose, and use of the contraceptive pill. Genetic vulnerability is also a causal influence.

Several of these factors are both causes of and effects of insulin resistance, creating a dangerous spiral. Being overweight is an example. Fat cells, especially abdominal fat cells, are a source of pro-inflammatory signals.

Metabolic Syndrome

Metabolic syndrome, also known as Syndrome X, is virtually synonymous with insulin resistance. The concept was first proposed by Dr Gerald Reaven MD in 1988 to cover a cluster of signs and symptoms that he often saw occurring together: high blood glucose, high cholesterol, obesity and high blood pressure. Reaven was the first to propose the mechanism of cellular insensitivity to insulin to explain this concomitance (3).

How To Avoid and Reverse Insulin Resistance

Fortunately there's a lot you can do to prevent and even reverse insulin resistance. Some people claim they can keep diabetes effectively under control (4).

- **Diet**: keep the proportion of your calories coming in the form of carbohydrates under control, making sure you have a substantial protein component to every meal. The carbohydrates you do eat should be low GL (5). Make sure you get beneficial fats, especially anti-inflammatory omega 3's (see the information sheet on fats). Eat low GL / high protein snacks between meals if you need to, to avoid hunger and fatigue - e.g. nuts are ideal snacks.
- **Lose weight** if necessary. Having said that, if you follow all the recommendations outlined here there is a good chance you will lose weight easily and naturally.
- Use **supplements** to boost your insulin sensitivity. York Mind-Body Health can make recommendations.
- Take steps to **reduce stress**. As mentioned, one of the physiological consequences of chronic stress is reduced sensitivity to insulin. Stress is of course common in modern life. Even if you feel you cope well with stress, it may be worthwhile to test your autonomic nervous system balance, or hormone levels. York Mind-Body Health can help with this.
- **Exercise** regularly - this increases your insulin sensitivity. But be careful if exercise makes you feel exhausted - you may do yourself more harm than good.
- **Avoid or limit caffeine** (coffee, tea and some soft drinks) because it raises blood glucose.
- **Stop smoking** if you smoke.

Of course all these things are far easier said than done - in fact they represent a considerable undertaking. York Mind-Body Health can help with all of them.

Suggested Further Reading

‘The Insulin Factor’ by Antony Haynes

‘The True You Diet’ by Dr John Briffa

Footnotes

1. This study was carried out by Professor Brand-Miller et al. at the University of Sydney and reported in the American Journal of Clinical Nutrition in 2002.
2. Eating slowly is a major part of Paul McKenna’s weight loss strategy in his book ‘I Can Make You Thin’.
3. See Reaven’s paper, ‘Role of insulin in human disease’ in the journal *Diabetes* (1988)
4. See ‘Fantastic Voyage: The Science Behind Radical Life Extension’ by Ray Kurzweil and Terry Grossman. Futurologist Kurzweil was diagnosed with type II diabetes at the age of 35. In the book he describes how he keeps himself free of any symptoms of diabetes.
5. See for example Patrick Holford, ‘The Low GL Diet Bible’ for help with how to follow a low GL diet.