Hormones Relevant to Fat Metabolism

In order to burn body fat effectively, we need to make sure that the metabolic mechanisms responsible for releasing fat stores and then burning them for energy, are all in working order. At the heart of these processes are the hormonal interactions that occur around energy metabolism. Hormonal signals can allow communication between different tissues, and also the brain, that may indicate energy status. This can impact on the selective use of fat, carbohydrate or protein for fuel, as well as the storage of fat and carbohydrate. If you're consuming an excess of energy (calories) then you will store body fat, but by understanding and appropriately regulating the hormonal environment and metabolic processes behind fat oxidation, we can optimise our weight-loss strategies.

Take Homes for the busy reader;

- Maintaining Insulin sensitivity is essential for health and longer term leanness
- Being insulin sensitive increases favourable nutrient partitioning whereby more nutrients are stored in and help rebuild muscle rather than being stored as fat
- Stress increases cortisol and cortisol receptors are higher in central fat
- Cortisol (excess) can make you crave sugar and generally ruin your life
- Inflammation decreases sensitivity to all hormones – eat an anti-inflammatory diet and supplement with natural anti-inflammatories
- An acidic diet can decrease insulin sensitivity and ruin your life – eat your veggies and look up PRAL lists keep your diet generally balanced for optimal health
- A teaspoon of bicarbonate of soda alkalises the body really fast and protects the kidneys
- Eating an alkaline diet might help you burn fat and train harder
- You need all these hormones just acutely and not chronically is the key try to increase clearance rates
- This means doing a mixture of fasting and feeding in a strategic manner
- Onions, garlic, ginger + plenty of protein and vegetables seems to be the order of the day
- Do resistance training this increases GH, insulin sensitivity and generally makes you more awesome
- If you are of a high body fat or know / train someone who is and they are struggling leptin sensitivity can be a real issue – you can test for this
- Don't drink calories especially fructose in excess

A few things which quickly help with all this as long as your energy balance is in order are; cinnamon increase glucose disposal into muscle cells, grapefruit enhances AMPK and insulin / glucose uptake into the muscle cells, fibre decreases hunger hormones and slows glucose delivery into the blood from meals, various teas including Gymnema and green tea aid all of this. Spices also generally lower inflammation and increase insulin sensitivity as well as providing plenty of antioxidants.

I make a nice range of organic, salt free spice mixes. Please add your preferred option when ordering and I'll pop a tub in for free. I've a BBQ mix, chili, Georgian spices (I learned when visiting and supporting the Georgian rugby team) Japanese 7 spice and an immune boosting mix which you can also use for cakes and home protein cookie baking.

Alpha lipoic acid is a fast way to increase insulin sensitivity and uptake of all nutrients into muscle cells including creatine. Alpha lipoic also helps with kidney, brain and liver health. I don't make alpha lipoic on its own – it's included in the Metabolic Amino Complex, but I think if you are interested in this area then you should source some for your personal use. Taking a gram (too much in my opinion) with creatine massively increased creatine uptake in a recent study. I personally use 100mg to 500mg daily. It's good with larger meals also for maximising glycogen restoration.

My Metabolic Optimiser combined with fish oils is a really fast way to lower inflammation and potentially increase hypothalamus hormone sensitivity. I'm so convinced your inflammation and pain will decrease with this combination that if it doesn't just return the unused pots and I'll personally refund you. The days I don't take it inflammation from training often wakes me up (I train hard).

I'll be sharing the training plan (next newsletter) I've been using for Ed Skrein – I've been getting him in awesome shape for the movie he's been shooting recently – he's totally shredded and 100% natural.

If you know anyone who will benefit from these newsletters please do forward this and get them to sign up here.

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So in terms of the detail around the hormones relevant to fat metabolism please read on for a more detailed bank holiday Monday discussion;

Enjoy and please share. Thanks.

If you know anyone who will benefit from these newsletters please do forward this and get them to sign up here.

Insulin – a double edged sword

Insulin is the indicator of the post-prandial (fed) state. It rises in response to blood-glucose, telling your body that energy is available, the body is fed, and therefore we should go about storing (energy) and building (tissue). It also exerts a much underappreciated role in maintaining muscle. As insulin coordinates various biological responses according to our blood-sugar/energy-status, appropriate regulation of this hormone is vital.

The effects of insulin on carbohydrate metabolism

Glucose mediated elevations in insulin upregulate enzymes involved in glycolysis, priming tissues to use glucose as fuel. This hormone also stimulates receptors on muscle tissue (called Glut 4) to take up blood-sugar in preparation for glycolysis – the breakdown of sugar for energy.

The effects of insulin on fat metabolism

Insulin signals that energy levels are high enough to begin storing (and stop breaking down) fat. The materials that fuel fat synthesis are redirected from the krebs cycle. In this way, building blocks from blood-sugar can be used to synthesise fatty-acids. Excess protein can also be converted into krebs cycle intermediates and be redirected into fatty acids, although this is an energetically expensive process. Insulin can also prevent the breakdown of body-fat (used as a reserve for when we are underfed) and increase the uptake of circulating fats into muscle and fat cells.

When resisting insulin may be beneficial

As Insulin stimulates the body to store excess energy, some compounds may aid weight-loss by opposing insulin -mediated fat storage and relieving insulin's inhibition of fat-release (lipolysis) One such example can be found in grapefruit juice. How then, can insulin resistance be problematic?...

Stress Hormones and Cortisol

Stress hormones include inflammatory mediators and Glucocorticoids (e.g. cortisol), so called because of their stabilising effect on blood sugar. They signal low blood-sugar levels and thus **oppose the actions of insulin** and stimulate the creation of glucose from non-carbohydrate sources (gluconeogenesis). They would usually **stimulate fat release and oxidation**, but problems can occur when these stress markers become elevated in the presence of blood-sugar and insulin.

Obesity and the Vicious Cycle of Insulin-Resistance

Normally, low blood-sugar levels and the presence of stress hormones and fats in the blood trigger further lipolysis and stimulate fat oxidation. This provides us with an alternative source of fuel when carbohydrate is scarce (i.e. in starvation). Fats attenuate insulin's effects. When increased levels of blood-sugar are coupled with increased circulating fats, insulin's actions are blunted. The body is trying to defend against starvation (signalled by high fat levels), while sugar and insulin are still present. This is frequently the case in overweight individuals, or those suffering from metabolic syndrome. Insulin resistance means glucose is now not taken up into cells and yet more fats are released into the bloodstream. Stress-marker release and inflammation can result (which oppose insulin), and this combination of the "fed" and "starved" states has been seen in obese populations to lead to a dramatic escalation in levels of circulating fats. The body releases fat, but with insulin rendered ineffective, these fatty acids stay circulating in the bloodstream rather than being appropriately stored when we are in the fed-sate. This results in elevations of "bad" cholesterol, formation of plaques on blood-vessel walls, and eventual deposition of metabolically-active abdominal fat. Circulating blood-sugar binds to fatty deposits, making them even more dangerous. Many studies on obese populations have correlated stress markers like cortisol with deposition of belly-fat and a greater likelihood of cardiovascular disease. Maintaining appropriate regulation of insulin-action then, is essential for the proper regulation of fat and sugar metabolism.

Once this state is reached however, it is self-perpetuating! The body's inability to sense insulin (due to high levels of circulating fat) means that the levels of insulin are increased to compensate, simultaneously reducing the number of insulin receptors in the body. Now the body's even less able to sense insulin, and the vicious cycle continues!

Summary of insulin

In Healthy Populations, Insulin...

- Preserves lean tissue
- Causes blood-sugar uptake
- Causes carbohydrate utilisation
- Stores excess energy-containing compounds as fat

In the Overweight, Insulin *Resistance* Means...

- Fat isn't taken up properly, being left to circulate the blood-vessels
- This is accentuated by inflammation and oxidative stress to increase abdominal fat
- And atherosclerotic plaque formation
- And deregulation of cholesterol transport
- Which makes fat more metabolically active and prone to cause cardiovascular disease

Cortisol and body-fat

As stated above, cortisol signals stress and initiates the metabolism of the starved-state. This means opposing insulin's actions and causing the body to break down its energy reserves, rather than build them up. Cortisol usually opposes the effect of insulin on the body's fat cells which is to stimulate fat uptake and storage. How then can cortisol be associated with increases in body-fat? Long term (chronic) elevations in cortisol cause the body to upregulate levels of fat receptors, trying to make best use of the scarce resources available. This is particularly so in the fat cells found around the abdomen. Abdominal fat cells seem to be most responsive to cortisol-induced increases in these fat-uptake receptors (called LPL). Therefore, although cortisol usually increases fat release and oxidation, inappropriate cortisol increases in the fed-state could actually increase abdominal fat storage. Such is the case in the obese. Although theoretically this could occur in healthy populations who are stressed despite being in the fed-state, actual research has only really correlated this increased cortisol activity in the overweight. In healthy populations, cortisol will only be at high enough levels to increase LPL when there is insufficient fuel to synthesise body-fat. Cortisol levels will then reduce in response to feeding, being opposed by circulating insulin. Insulin resistance, caused by high circulating fats in the fed state (i.e. in the overweight) could possibly cause a fat-accumulating effect of cortisol. Studies are still far from reaching firm conclusions on these effects. Some studies have associated increased levels of cortisol with abdominal fat in the overweight, while others have found that while total levels remain constant (Misra, et al., 2008), a greater rates of cortisol secretion and elimination may be responsible (Stewart, Boulton, Kumar, Clark, & Shackleton, 1999). It could possibly be the case then, that chronically high levels of cortisol will prime the body for fat storage, rather than exerting the usual effect of acutely stimulating fat-burning. This may have more relevance to athletes than is initially obvious, however, as training

increases *resting* levels of cortisol in athletes. ***This chronic elevation in cortisol then may have the potential to be detrimental to our fat-burning goals if left unaddressed***.

Growth hormone

Whereas insulin is powerfully anabolic in all respects, encouraging synthesis of fat and muscle tissue, growth hormone (GH) can be thought of more as anti-catabolic. Its effects are more to preserve and promote muscle metabolism, while stimulating fat oxidation to provide energy for these processes in the absence of blood-sugar. In the starved state, when blood-sugar is reduced, GH is released and stimulates fatty acid-release and oxidation. This serves as a source of energy to support GH-mediated muscle synthesis and maintenance. These effects can further reduce insulin-action via fatty-acid inhibition. This allows more fatty-acid release, as insulin's inhibition of this process is relieved. Acute insulin action however stimulates muscle to absorb glucose and suddenly reduces blood-sugar, serving to lower circulating glucose (inducing acute hypoglycaemia), and enhance GH release. In contrast, if plentiful glucose and prolonged insulin elevations are combined, then GH can assist in storing excess energy as fat and glycogen. Therefore, the most apparent benefits of GH would be observed when carbohydrate use is high, following high intensity exercise, or when intake is low, for example when weight-making or undergoing a fat-loss strategy. However, care must be taken that overtraining and chronic elevations in cortisol are kept to a minimum as these will counteract GH effects (Miller & Leisti, 1984).

Testosterone

The effects of sex steroids on fat metabolism are obviously extremely sex-dependent, but generally testosterone enhances fat-release, particularly from around the abdomen, while opposing the action of the LPL fatty-acid import receptors. These effects have been seen to be reversed in obese females, however, but for a healthy male, the presence of this sex-hormone correlates with appropriate fatty acid metabolism and decreased levels of abdominal fat (Saleh, Sniderman, & Cianflone, 1999).

Leptin

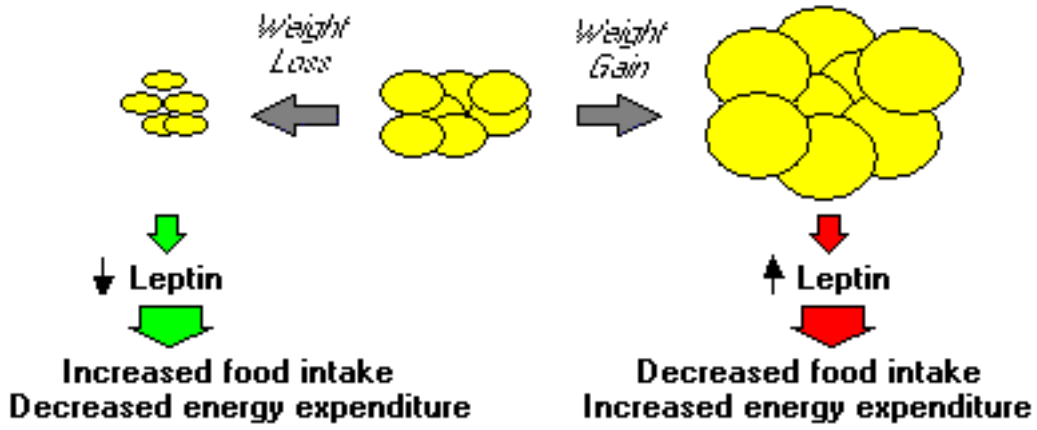
Leptin (from the Greek *leptos,* meaning thin) is a protein hormone with physiological effects on appetite and regulating body weight.

Leptin is a mediator of long-term regulation of energy balance, suppressing food intake and thereby inducing weight loss (4)

Discovered in the mid 90's when scientists who administered it to obese mice found that the rodents subsequently lost weight.

Unfortunately, it doesn't work in the same way on humans. It only has a weight loss effect on obese people who deficient in it (~5-10% of people).

Leptin is predominantly secreted from adipose tissue (fat tissue) and the amount expressed correlates well with the lipid content of the cells (1)



The less fat you have the less circulating leptin will be present, meaning you will eat more. The more fat you have, the less circulating leptin, meaning you will eat less (theoretically). As long as you are leptin sensitive.

After secretion from adipose tissue, leptin signals to the brain, primarily to the hypothalamus, giving information about energy stores in the body. This results in decreased energy intake and increased energy expenditure to maintain body fat stores (4).

With diet induced obesity, despite leptin levels rising proportionally with body fat levels, these elevated levels fail to prevent weight gain. Leptin resistance is a characteristic of obese humans (2).

Leptin resistance is similar to insulin resistance in that despite the elevated circulating levels of the hormone, the body does not respond as it would in healthy subjects.

Chronic feeding of fructose appears to be linked with leptin resistance (2).

As fructose does not stimulate insulin secretion from the pancreatic β-cells, the consumption of meals containing lots of fructose produces less insulin than a meal higher in glucose. As a leptin response is regulated by insulin response to meals, fructose consumption results in less circulating leptin meaning hunger may not be suppressed (3).

The implications of this mean that chronic consumption of diets high in fructose, or more specifically, high-fructose corn syrup, could be conducive to weight gain in the long term (3).

Diet induced obesity promotes chronic-low grade inflammation in both peripheral and brain tissues. In the hypothalamus, the immune response to excess nutrients may play a role in diet induced leptin resistance and adiposity (5).

While it is common knowledge that leptin deficiency can be corrected with correct therapy, correcting resistance in common obesity continues to challenge us. However, some pre-clinical studies have highlighted novel approaches which may show leptin resistance as a reversible condition.

Green tea has long been used for its reported health benefits, derived from the Camellia sinensis leaves (6). Tea saponin, an important components of the Camellia sinensis leaves, has recently been reported to have a positive effect on reducing obesity, peripheral and hypothalamic inflammation and central leptin resistance in high-fat diet induced obese mice (7).

This research is still in its infancy, but it is definitely something to consider.

Summary of Leptin

- A long-term mediator of energy balance
- Leptin therapy on resistant subjects only works if they are deficient
- Resistance maybe induced by chronic overfeeding of foods containing high-fructose corn syrup or its derivatives

Practical implications

- Avoid foods containing high-fructose corn syrup (HFCS) and its derivatives
- Green tea contains a compound which may have a positive effect on hypothalamic inflammation and leptin sensitivity.

Ghrelin

Whilst leptin is a long-term regulator of body weight, ghrelin is a fast acting hormone that initiates cascades to tell us we are hungry. An increase in pre-meal levels of ghrelin correlates with hunger scores in healthy humans, even with an absence of time and food related cues (8).

In an obese population, we would expect levels of leptin to be low and ghrelin to be high. This is not the case. It is not clear if these quirks in the leptin and ghrelin systems are a cause of or a consequence of obesity (8).

Long term weight loss is an important, but often elusive, goal as weight regain post-diet is a common occurrence (9).

Could leptin and ghrelin play a role in weight regain following a diet?

Set Point Theory attempts to explain why weight regain is an all too common occurrence amongst dieters. According to this theory there is a set point in all of us which dictates how much body fat we should carry. Some have a naturally high point, while others have a low point. Going on a weight loss diet attempts to overpower this set point triggering the body to attempt to mitigate the weight loss through manipulation of hormones such as leptin and ghrelin (15).

The set point is very good at maintaining a certain weight, as it has a better insight into body fat stores. The body cannot tell the difference between a diet and starvation and so kicks into action various mechanisms to initiate weight regain (10).

So far, the only way to effectively to lower the set point is through a sustained increase in exercise (11).

Another way to attenuate post-feeding ghrelin secretion is to consume meals based around a quality protein source. When compared with a meal which is high in carbohydrates, the high protein meal suppressed ghrelin secretion meaning less hunger in the hours following the meal (14).

Other ways to improve leptin and ghrelin levels include getting regular, good quality sleep and supplementing with fish oils (12, 13).

Summary of ghrelin

- Secreted by the stomach
- Send signals to the hypothalamus to instruct to search for food
- Does not work as we would expect in an obese population

Practical implications

- Poor quality or lack of sleep can increase levels of ghrelin
- Exercise could be a way to reduce body fat set point
- High protein meals suppress ghrelin post-feeding
- Supplementation with fish oils

Glucagon

Glucagon, secreted from the alpha cells in the pancreatic islet, is responsible for the breakdown of stored glycogen during periods of low energy intake, fasting or hypoglycaemia. It is vital for the counter regulation of blood glucose levels (1).

There are three proposed mechanisms as to the activation of glucagon from the pancreatic alpha cells; a direct effect of low glucose, an inhibitory effect of pancreatic beta cells, a stimulatory effect of autonomic activation (2).

The primary role of glucagon is to signal the body to release stored glycogen when blood sugar levels fall too low. However, a growing body of evidence suggests that glucagon plays a role in the regulation of appetite through signalling to the body to reduce levels of other hormones like ghrelin (3).

High levels of glucagon (hyperglucagonaemia) leads to physiological and behavioural responses such as increased availability of energy substrate and improved cardiovascular performance, which are key features of a stress response such as that which is seen from exercise (4).

Glucagon secretion is increased during periods of intense exercise (5). The sympathoadrenal system is of major importance for liver glucose production during high intensity exercise bouts (6).

Catecholamines are potent stimulators of glucagon and under certain circumstances the reverse is true (7).

In diabetic patients, the combination of deficient glucagon and adrenaline responses cause defective glucose counter-regulation. Reduced sympathoadrenal responses cause hypoglycaemia unawareness. By moving glycaemic thresholds for the sympathoadrenal system, hypoglycaemia

leads to a vicious cycle or recurrent low blood sugar and further impairment of glucose counter-regulation (9).

Summary of glucagon

- Secreted by pancreatic alpha cells in healthy individuals
- Is a glucose regulator
- Stimulated during intense exercise
- Regulation can become disrupted in overweight and obese individuals

Practical Implications

- Stay within a healthy weight for your height and age
- Regular exercise to reduce chronic stress and improve insulin sensitivity
- Avoid spiking blood sugar too often

Summary

Quite simply then, we must ensure that the usual metabolic mechanisms responsible for energy provision are functioning adequately and supported in doing their job.

Insulin

- Acute insulin sensitivity involving carbohydrate disposal is desirable
- Chronic Insulin elevations will likely reflect frequent blood-sugar ingestion and positive energy balance, while also encouraging fatty acid synthesis and storage

Growth Hormone (GH)

- supporting GH production is desirable to aid fatty acid oxidation and muscle metabolism
- This positive impact on body-comp may be supported by acute insulin sensitivity and carbohydrate disposal
- Chronic blood-sugar and insulin elevations, combined with likely associated positive energy-balance may result in GH aiding fat *storage*

Cortisol

- Chronic elevations in cortisol are likely to impair training adaptations, appropriate fat-metabolism and induce muscle wasting
- Acute elevation will only occur after high intensity sessions in trained athletes and will promote fat oxidation

Testosterone

- Associated with lower central adiposity
- Drive and successful outcomes in sports
- Helps with keeping you frisky, happy and motivated

Leptin

- Regulates metabolism and fat burning
- Can get messed up by inflammation
- Lowering brain inflammation keeps this working properly
- Might be slowing down your fat loss is dysregulated

Ghrelin

- Makes you hungry or full
- If you are too hungry sticking to a diet is harder
- Lower with plenty of fibre and good fats
- Green tea, fish oils and other compounds can help
- Not sleeping properly impact this hormone negatively

OPTIMAL HABITS FOR MAINTAINING MAXIMAL HORMONAL OUTPUT

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