

## Ketogenic diets - sporting performance and clinical applications



In terms of dietary trends, we're at a point in time where it is clear that certain approaches work better or worse for certain individuals. This was certainly the case for **Paul Ehren's** case study Claire, who responded exceptionally well to a full keto diet.

**C**onventional sports nutrition advice has traditionally recommended high-carbohydrate low-fat (HCLF) diets, particularly for endurance athletes. The 'pasta parties' held the day before many marathons is the perfect case in point. Fuelling is but one aspect of the argument; immunity and recovery have both also been referenced as reasons for the ingestion of high levels of starchy carbohydrate, both in training and competition (1,2).

However, this paradigm cannot be taken as a universal panacea because there are always genetic outliers who strongly buck this trend and thrive on a low-carbohydrate high-fat (LCHF) diet, which has led to a number of other nutritional strategies being adopted by coaches and athletes.

Arguably the most extreme form of LCHF is the ketogenic diet and this, together with an acknowledgement of intermittent fasting (IF), and their application for both sporting and clinical purposes by a female competitive athlete, is the subject of this case study.

### Claire's historic HCLF eating patterns

Claire Booth, currently 47 years of age, was a

very successful competitive bodybuilder during the 1990s and early 2000s, winning almost 30 titles nationally and internationally. A couple of retirements and returns to the stage took place before she finally hung up her posing bikini in 2010.

Competing in the 'Toned or Athletic' figure class (57kg), Claire employed the classic bodybuilding dietary regime of six meals per day, with a HCLF macronutrient focus and a consumption of around 200 g carbs per day. During contest preparation she cut her carbohydrate consumption to only that of green vegetables – this helped her to obtain the 'ripped' muscular look required. During this period of time, she usually lost her menstrual cycle within the first four to six weeks, plus she experienced poor sleep patterns, a lack of energy, bad skin, painful joints and general low mood and poor temper.

Post-competition, she would experience an inevitable rebound in body fat when she returned to 'normal' eating patterns. This cyclic eating pattern continued for most of her competitive career.

In 2008, Claire discovered both kettlebells and the international strength training company

StrongFirst, led by the well-known Russian strength and conditioning specialist Pavel Tsatsouline. Claire is currently the British event coordinator and senior instructor for the company, which requires her to travel and teach in the UK, USA, Europe & Asia.

### Claire's migraine attacks

Over many years, Claire has conducted an impressive amount of research into her own nutritional strategies. It is important to realise that her motivation to do so was drawn, not only from her desire to perform and look better, but also from a debilitating medical condition – migraines.

Her first migraine attack was around the age of 20, which at the time appeared to be a one-off event. However, they returned in her mid-30s and became progressively more frequent as she got older, averaging four per month, sometimes increasing to six to eight per month, with her worst period peaking at five per week. These attacks included visual auras, crippling headaches and nausea, normally requiring complete bed rest.

Both Claire's mother and grandmother had also suffered with migraines, so it was put down in the usual way to genetics. A variety of medications were prescribed for her, including Amitriptyline, Sumatriptan and Pizotifen, but without any success.



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Jumping in time to 1911, the first modern studies were carried out on IF (3), which eventually went mainstream in 1916 when Dr McMurray published a fasting and sugar/starch free diet protocol in the *New York Medical Journal* (4). The mass media, and therefore the general public, started to adopt the approach in the 1990s when the Hollywood producer Jim Abrahams successfully obtained treatment for his son Charlie's epilepsy. This led to the film *First Do No Harm*, starring Meryl Streep, and the formation of the charity The Charlie Foundation, which still continues its work to the present day.

The ketogenic diet, as opposed to IF, was bought into focus in 1921 when Rollin Turner Woodyatt's research into diabetes highlighted the role of three compounds: beta hydroxybutyrate, acetoacetate and acetone (referred to collectively as ketone bodies). These were produced in the liver during conditions of starvation or extremely low carbohydrate availability. This work continued with Woodyatt and his colleagues, who coined the term 'ketogenic diet'.

A full description of the pathways leading to the formation of the ketone bodies is beyond the scope of this article, but in summary, dietary fatty acids, or those liberated from adipose tissue, are subjected to a process of beta-oxidation, with the resulting acetyl-CoA entering the Krebs cycle, where in combination with oxaloacetate, the reduced coenzymes NADH and FADH<sub>2</sub> are generated. Oxidation of these coenzymes in the electron transport chain releases the energy required for the re-synthesis of ATP.

In circumstances of chronically reduced glucose availability, which in the context of this article will be in fasted conditions or when a

diet extremely low in carbohydrate is adopted (classically defined as less than 20g per day), the liver reacts in a different way: oxaloacetate is diverted to the gluconeogenic pathway, leaving the acetyl-CoA to be utilised in the hepatic formation of beta hydroxybutyrate, acetoacetate and acetone.

Of these three ketone bodies, the first two are transported to peripheral tissues where they can be re-converted to acetyl-CoA in the tissue mitochondria for use as an energy source. This applies to practically all tissues, including the heart and skeletal muscle. Ketone bodies are also able to cross the blood-brain barrier to maintain neural function. It can be noted that red blood cells, having no mitochondria, must rely on anaerobic glycolysis for their energy production, and although the liver is the source of ketone body production, it can't utilise them as an energy source because it lacks the enzyme thiophorase.

### **Claire's dietary evolution**

A number of years ago, Claire started to read *Primal Nutrition: Palaeolithic and Ancestral Diets for Optimum Health* by Ron Schmid. She adopted a modified form of the protocol and found that she no longer suffered post prandial dips in energy and mood patterns. She then experimented with IF, which ranged from 16hr:8hr ratios to full 72 hour fasts. Maintenance of these fasts was never a problem and athletic performance (bodyweight resistance training, barbells, and kettlebells) actually improved.

Even though some improvements in general health were experienced, the migraines unfortunately continued. Dietary experimentation continued for some years until she experienced another extended period of poor memory, brain fog, skin breaks-outs, significant mood swings,

Beta blockers and the contraceptive pill were also suggested by her doctor, but she refused.

Being a strength and conditioning specialist and a nutrition practitioner, Claire recorded migraine frequency, menstrual cycle, diet, sleep and stress levels, but without any obvious pattern emerging. She also underwent blood, hormonal (DUTCH) and food intolerance testing, which again did not produce any clear answers. Until recently, these attacks have been managed and tolerated, but not cured.

### **History of the ketogenic diet and intermittent fasting**

Considering the history and theory behind the use of the ketogenic diet and intermittent fasting (IF), they started as remedies for another neurological condition – epilepsy. Far from being a modern phenomenon, we can actually go back to Hippocrates in 400BC, when 'the father of modern medicine' proclaimed that far from being a curse sent from the Gods, which was the perceived wisdom at the time, epilepsy was in fact a disease that could be treated and cured by dietary intervention. This incredible foresight was taken up by other physicians of the time, including Erasistratus and Galen.



## Case study



► and an increased rate of migraine attacks.

This led to more testing; early menopause was initially considered, but hormonal assessment ruled this out.

At this point, Claire started to further research ketogenic diets and their clinical application through the work of Dominic D'Agostino, Stephen Phinney, Jeff Volek and Eric Westerman.

She purchased a blood glucose and ketone monitor and the initial daily macro count that she followed was: protein 40g, carbohydrates 20g, fat 150g, giving an overall Kcal input of 1590. Two things stand out on this so-called 'clinical keto' protocol; firstly, the obvious very low level of carbohydrate intake, but secondly the protein level only equated to approximately 0.6 g per kg body weight based on Claire's weight at the time of 65kg.

Over the coming weeks, energy levels dipped, but interestingly the migraines completely stopped.

At this point a quick delve into Claire's individual lipid metabolism will be helpful. She had undergone DNA screening with Nordic Labs, which disclosed the following results:

GENE	VARIATION	CLAIRE'S RESULT
LPL	1595 C-G	CC
CEPT	279 G-A	AG
APOC3	3175 C-G	CC
APOE	E2/E3/E4	E3/E3

It can be seen from these results that her ability to metabolise fats is not genetically compromised.

Apart from her slight drop in energy levels, other performance decrements included: exercising heart rate was more elevated than usual, and her recovery was taking longer than normal.

Research has shown that keto diets can cause disruption in the body's electrolyte balance, and after a period of experimentation Claire found that the introduction of a daily dose of seven grams of Himalayan salt sorted out both the elevated heart rate and poor recovery rate.

Claire then amended the exact makeup of the strict clinical keto approach and continued to experiment with her food intake. At the date of writing, Claire is consuming 1600 to 1800 Kcal/day at a body weight of approximately 60kg. Approximately 25 per cent of her calories come from protein – higher protein levels were shown

to spike blood glucose levels and take her out of ketosis. She restricts her carbohydrates to 20g, and the remainder of her diet comes from fats.

An example of her daily dietary intake is:

<b>5am</b> – Wake up, consume apple cider vinegar, Himalayan sea salt and black coffee
<b>Two hours</b> admin work, emails, social media etc
<b>Coffee, coconut &amp; cream, plus resistance training</b> (always completed fasted)
<b>Homemade bone broth</b>
<b>1pm lunch</b> – If traveling or busy with StrongFirst requirements this is often skipped, but examples are: <ul style="list-style-type: none"> <li>• Egg and cheese omelette, spinach, extra virgin olive oil</li> <li>• Scrambled eggs with cream, spinach, olive oil</li> <li>• Homemade 'Fat Bomb' (mascarpone, double cream, peanut butter, cacao powder, desiccated coconut, all fashioned into balls – approx. 150 Kcal and 15g fat).</li> </ul>
<b>3pm</b> – Coffee, coconut and cream, bone broth
<b>8pm dinner</b> – e.g. Coconut chicken curry with cauliflower and broccoli rice fried in butter or avocado oil with crushed garlic and ground pepper.

It must be appreciated that Claire ensures that she only eats pasture raised organic meats, poultry, eggs and dairy, and all her vegetables are also sourced from organic producers.

The ketone levels that Claire has recorded when feeling 'on top of her game' is 1.5 mmol/l. The highest she has experienced is 3.5 mmol/l, which conventional medicine would be getting extremely nervous about due to a perceived risk of acidosis – but this is possibly a confusion between nutritional ketosis and diabetic acidosis, which is seen in type 1 diabetics.

Her blood glucose has been recorded as 3.1 mmol/l at its lowest, with no apparent ill effects, and it averages 4.3 mmol/l one hour post prandial.

To quote Claire: "I currently have no migraines, I only need five to six hours of sleep, with no mid-afternoon dip in energy, my mental clarity has improved, I am leaner than I have been since my competitive bodybuilding days, I am satiated after meals for longer, my moods are better, particularly during my monthly cycle, my skin condition has improved, my strength and power have improved, and I have recently hit lifetime best lifts. Even though I've had numerous people telling me I would lose muscle tissue, this certainly does not appear to be the case." As an aside here, beta hydroxybutyrate has

been shown in some studies to be anti-catabolic and a safeguard against the gluconeogenesis breakdown of muscle tissue.

### In summary

This article is certainly not a personal crusade to promote the general use of a keto style diet; Claire readily admits that her success is probably due to a combination of her individual genetic lipid metabolism and attention to detail in both sourcing her produce and implementation of the diet.

However, she strongly believes that without the ability to thrive on ketones, our distant ancestors would never have survived, and that we have become dependent upon refined and overly farmed crops that cause chronic inflammation, obesity and metabolic syndrome: "we burn what we feed the body, making it impossible for many to access their fat stores as a systemic source of fuel."

My personal thoughts, for what they are worth, is that I am instinctively suspicious of any elimination diet, particularly used in the long term. Without doubt, though, this protocol has been tremendously successful for Claire from a clinical, performance and aesthetic standpoint, but we need to be aware of her individual biochemistry and her religious attention to detail, neither of which are likely to be shared by the majority of athletes.

Interestingly, Claire adopts the anti-glycolytic training principles practiced by Pavel, which may be one reason why we do not see a performance decrement. I would normally expect to encounter them on a high fat diet, especially during intense training periods in excess of 70% VO<sub>2</sub>max.

Without doubt we can learn from Claire's journey and use at least some of the elements she has adopted. In much the same way as a musician absorbs any number of styles and influences when developing their own techniques and unique sound, we, as nutritionists, should remain open to all of the dietary systems available to us; they all have features worthy of use or at least further research.

There is no black and white, only shades of grey. **fsn**

• References available upon request

### ABOUT THE AUTHOR



**PAUL K EHREN** is a master personal trainer, NABBA qualified coach and was one of the first graduates to take and pass (with distinction) the Certificate of Integrative Sports Nutrition. As an athlete, Paul is a former British Masters Bodybuilding Champion and has won

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