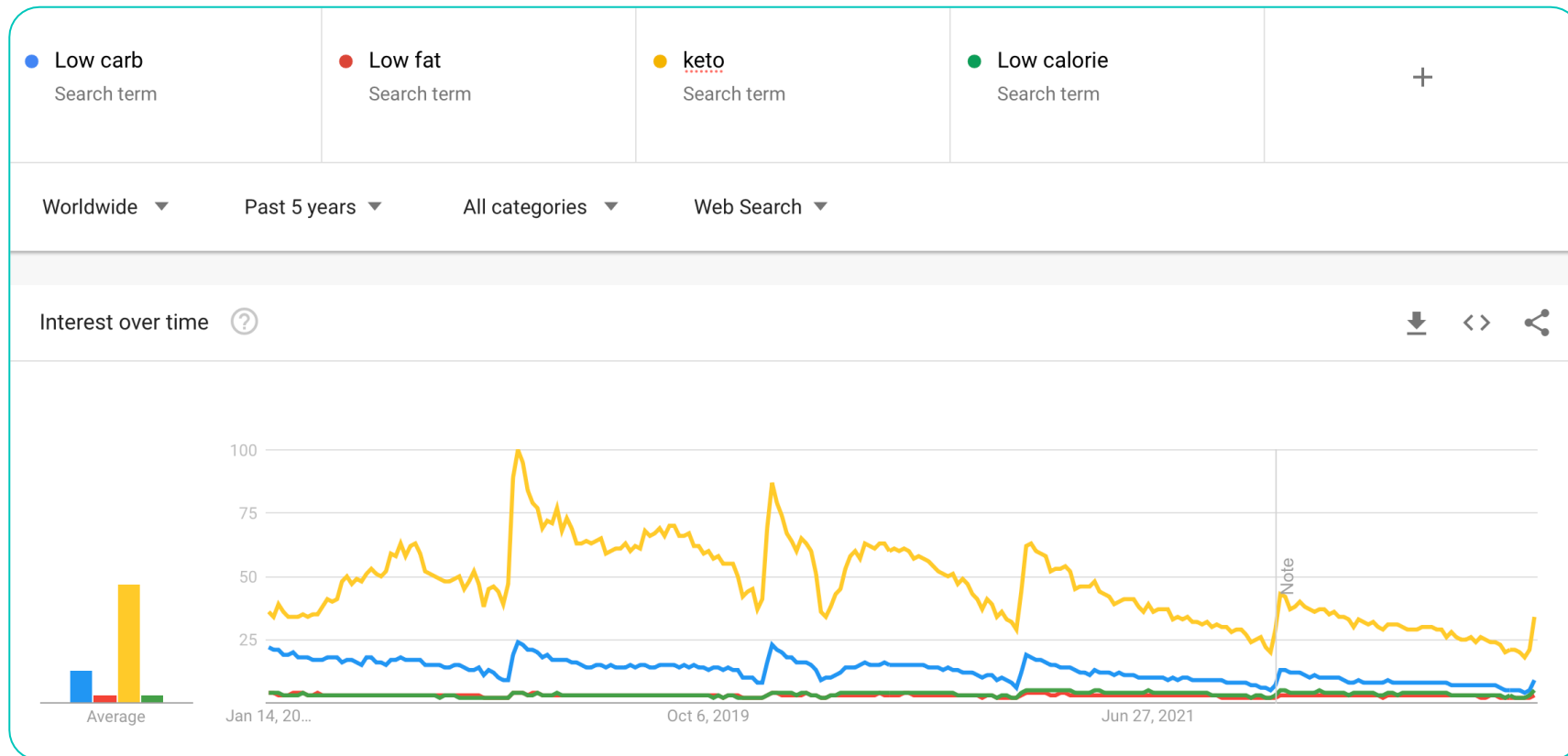


Low Carbohydrate Diets

Are they just a fad?

Google Trends 5 year Interest by Diet Type



Low Carbohydrate Diets, are they just a fad?

AGENDA

The Basics

The Science Bit

Low Carbohydrate Diets in Practice

How sustainable are Low Carb diets?

What is a carbohydrate?

- Used as a source of energy for the body
- Molecular formula $(\text{CH}_2\text{O})_n$
- Type of carbohydrate depends on “Degree of polymerisation” (DP) which is the number of monomeric units
- Sugars (1-2 DP monosaccharides and disaccharides)
- Polyols (1-2 DP sugar alcohols)
- Oligosaccharides (3-9 DP)
- Polysaccharides (>10DP starch/non starch)
- The greater the number of monomers, the more complex (and less sweet) the carbohydrate becomes



What types of foods are carbohydrates?

Monosaccharides (1-2 DP)

Glucose, dextrose, fructose



Oligosaccharides (3-11 DP)

Sucrose, lactose, maltose, fructans, galactans, polyols



Polysaccharides (12+ DP)

Starches, dietary fibre



Non-starchy polysaccharides



What is the recommended daily intake?

- UK Dietary Reference value for carbohydrates is 50% of total daily energy intake
- Each gramme of carbohydrate is equal to 4kCals of energy
- This means
 - for the average male that is $(2500 \text{ kCals per day} \times 50\%) \div 4 = 312.5 \text{ grammes per day}$
 - For the average female that is $(2000 \text{ kCals per day} \times 50\%) \div 4 = 250 \text{ grammes per day}$

There is no official definition of "Low Carb", diets start as low as 5% of total daily intake

What does that look like?

- See examples



The Science Bit

Low Carbohydrate Diets, are they just a fad?

Energy Requirements and Balance

$$\text{TDEE} = \text{BMR} + \text{EAT} + \text{NEAT}$$

Eat less, move more!

Application of the first law of thermodynamics

$$\Delta E = E_{\text{in}} - E_{\text{out}}$$

Applied to weightloss: change in fat mass = Energy Consumed – Energy Expended (CICO)

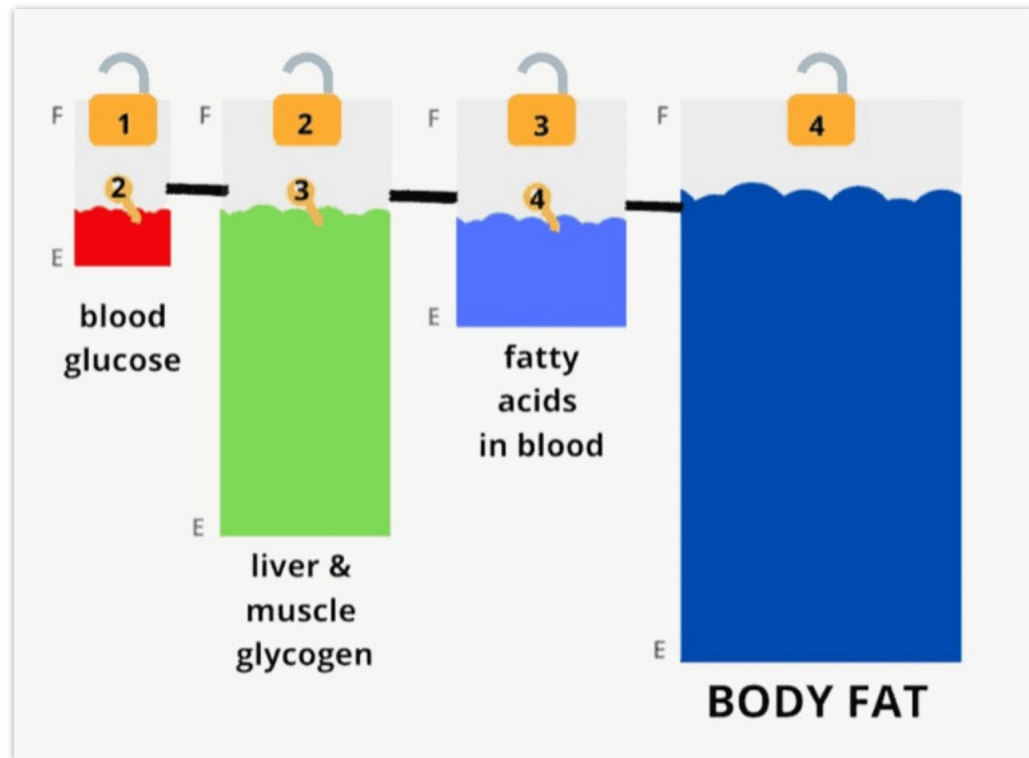
- Energy balance only considers the number of kCal in any given food without any concern for the nutritional composition or degree of processing
- Many people fail to lose weight despite being in calorie deficit

What if there's a different reason for gaining weight?



Oxidative Priority and Insulin Resistance

- Glucose isn't the only energy source
- Insulin resistance “locks” in excess energy stored in the form of fat
- Low Carbohydrate diets keep blood glucose, glycogen stores and insulin levels low
- Low insulin levels help reverse insulin resistance, and sensitivity returns, allowing easier access to fat stores as an alternative energy source to glucose



The Carbohydrate-Insulin Model of Obesity

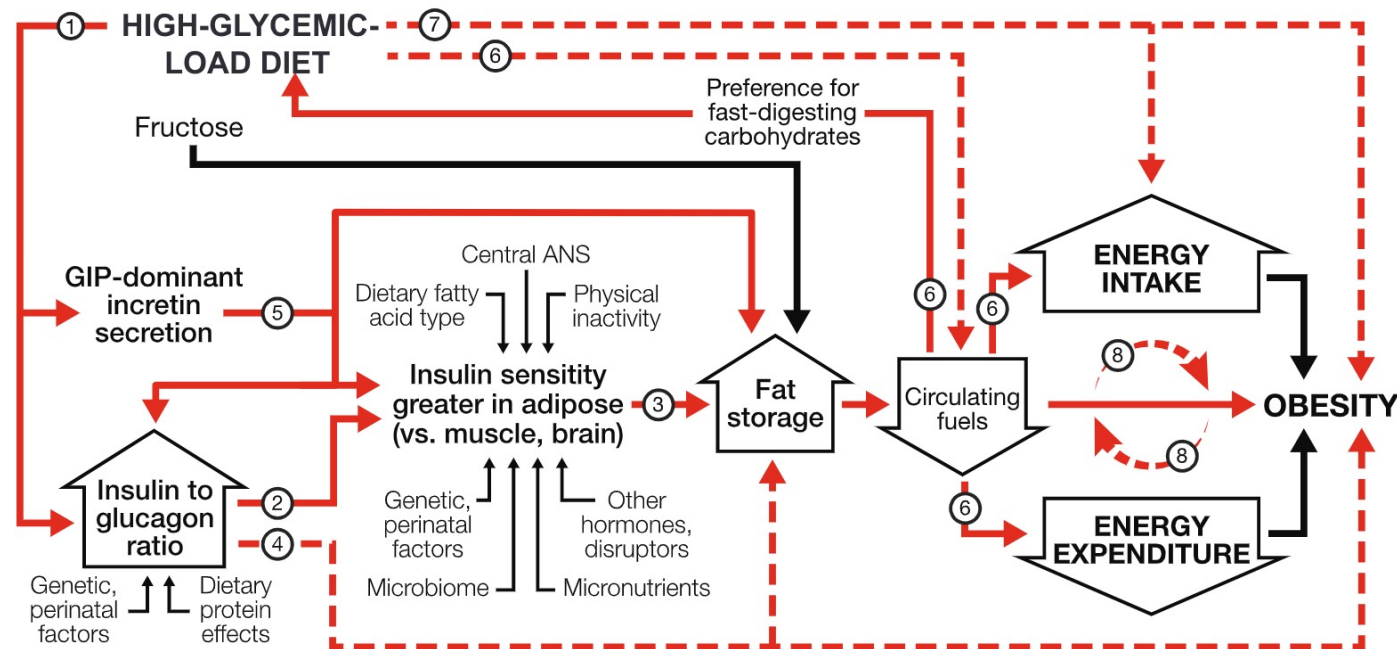


FIGURE 1 Dynamic phase of obesity development in the carbohydrate-insulin model. The relation of energy intake and expenditure to obesity is congruent with the conventional model. However, these components of energy balance are proximate, not root, causes of weight gain. In the compensatory phase (not depicted), insulin resistance increases, and weight gain slows, as circulating fuel concentration rises. (Circulating fuels, as measured in blood, are a proxy for fuel sensing and substrate oxidation in key organs.) Other hormones with effects on adipocytes include sex steroids and cortisol. Fructose may promote hepatic de novo lipogenesis and affect intestinal function, among other actions, through mechanisms independent of, and synergistic with, glucose. Solid red arrows indicate sequential steps in the central causal pathway; associated numbers indicate testable hypotheses as considered in the text. Interrupted red arrows and associated numbers indicate testable hypotheses comprising multiple causal steps. Black arrows indicate other relations. ANS, autonomic nervous system; GIP, glucose-dependent insulinotropic peptide.

- The Carbohydrate-Insulin Model takes into consideration hormonal responses to carbohydrate intake

Ludwig et al.

Hormonal Regulation: Blood Glucose, Insulin, Cortisol, Glucagon, Leptin, Ghrelin

- Blood Glucose – 3.5-5.5mmol/L before a meal – High BG = Hyperglycaemia Low BG = Hypoglycaemia
- Insulin – created by pancreas controls amount of blood glucose in bloodstream. Regulates metabolism of carbohydrates, fats and proteins. Linked to overweight and obesity when too much fat stored in and around the liver and pancreas causing insulin resistance.
- Cortisol – Pituitary gland reacts to exercise/stress sending signal to adrenal gland to release cortisol – raises blood sugar by releasing stored glucose too high can lead to T2DM.
- Glucagon – Converted into glucose in the liver released into the bloodstream. Gluconeogenesis.
- Leptin – Produced from adipose tissue. Estrogen induces leptin.
- Ghrelin - "The hunger hormone" produced in the stomach enters bloodstream and hypothalamus initiating hunger. Hypothyroidism. Stimulates appetite and growth hormone. Glucose homeostasis.

Low Carbohydrate Diets in Practice

Low Carbohydrate Diets, are they just a fad?

Low Carbohydrate Diets in Practice

Weight Loss

- ✓ Paleo
- ✓ Low Carb, High Fat (LCHF)
- ✓ Keto

Clinical Settings

- ✓ Epilepsy
- ✓ Cancer
- ✓ Diabetes
- ✓ Alzheimers
- ✓ PCOS

Sport

- ✓ Training vs competition
- ✓ Endurance vs Strength/Power

Weight Loss: Why is Low Carb even a 'thing'?



- 1860s – William Banting published his "Open Letter on Corpulence" outlining his weight loss success using a low carbohydrate diet
- The "Banting Diet" became a popular low carbohydrate weight loss protocol focused on whole foods and restricting processed foods, sugars, starches, butter, milk and beans
- Prof Tim Noakes' updated version of the Banting diet more closely resembles "keto"

Weight Loss: The Paleo Diet (~120g Carbs)

Paleo Advantages

- Weight loss
- Improved glucose tolerance
 - ↓ HbA1c
- Reduced blood pressure
- Improved cholesterol markers
 - ↓ LDL
 - ↓ Triglycerides
 - ↑ HDL

Paleo Disadvantages

- No grains affects the balance of gut microbiota.
- Elimination of most dairy
- Deficiencies in calcium and vitamin D and B

Weight Loss: Low Carb, High Fat (LCHF) (up to 50g Carbs)

LCHF Advantages



Weight loss



Reduced appetite



Increased satiety



Reduced inflammation



Improved hormonal regulation

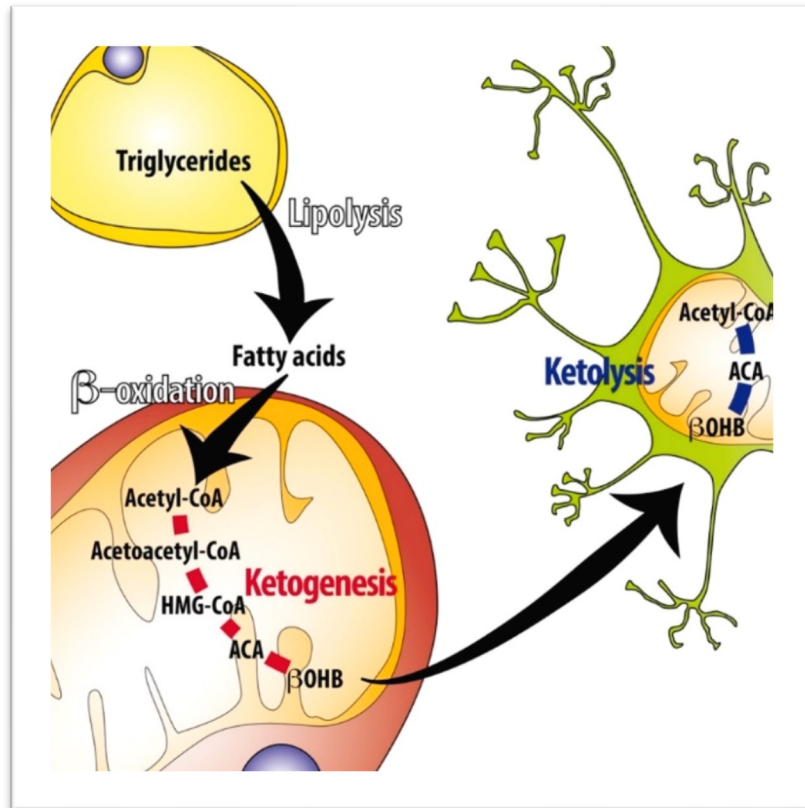


Reduced health risks due to improved health markers

LCHF Disadvantages

- Saturated fat can be overconsumed
- Nutritional imbalances
- Short lived metabolic efficacy
- Increase in LDL cholesterol

Weight Loss: The Keto Diet (<20g Carbs)



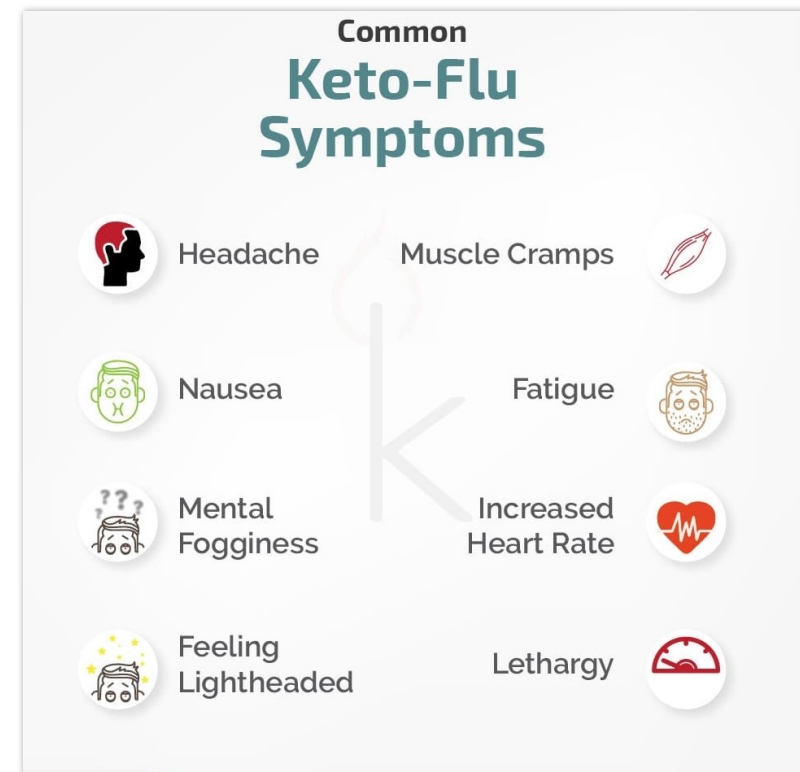
Keto Advantages

- Prolonged fat oxidation (burning) results in the production of **ketones** beneficial to heart and brain function (cognition), increased fat metabolism and muscle
- Often rapid weight loss
- Reduced appetite
- Increased satiety
- Reduced inflammation
- Improved hormonal regulation
- Reduced health risks due to improved health markers

Weight Loss: The Keto Diet

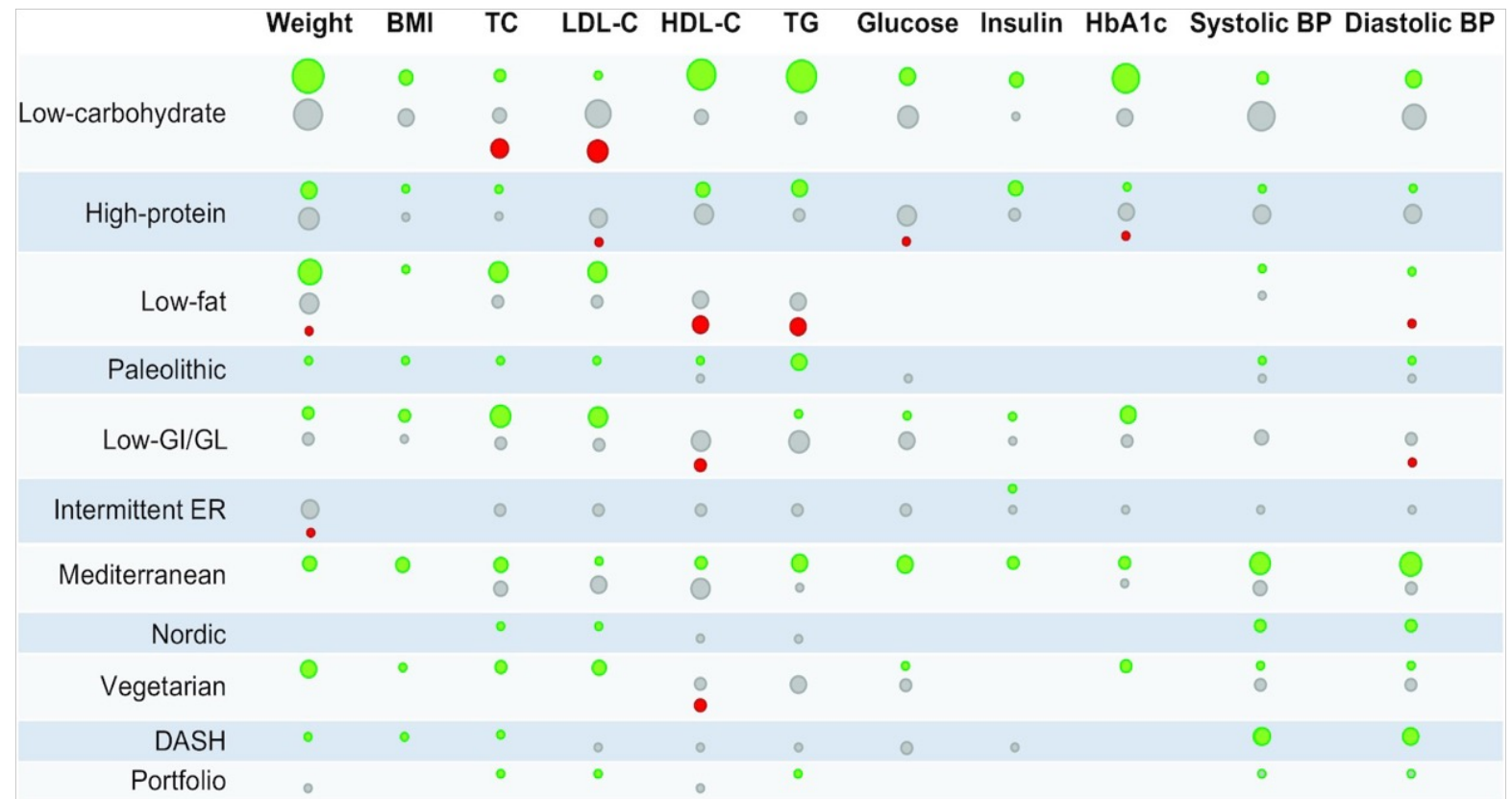
Keto Disadvantages

- Lack of fibre.
- Kidney function
- Fatigue, keto flu, bad breath
- Increase cholesterol
- Adherence



Umbrella Review of Low Carb RCTs and Meta Analyses

Source: "Effects of popular diets on anthropometric and cardiometabolic parameters: An umbrella review of meta-analyses of randomized controlled trials"



Low Carb Diets in Clinical Settings

Clinical Settings: EPILEPSY

- Developed in the 1920's by Dr Russell Wilder as treatment for children in controlling seizures.
- By depleting the body of sugar, increasing fat intake mimicking the effects of fasting.
- Reducing the amount of glutamate in the brain enhances synthesis of GABA.
- 4:1 ratio of fat to 1 portion of protein plus carbohydrate.

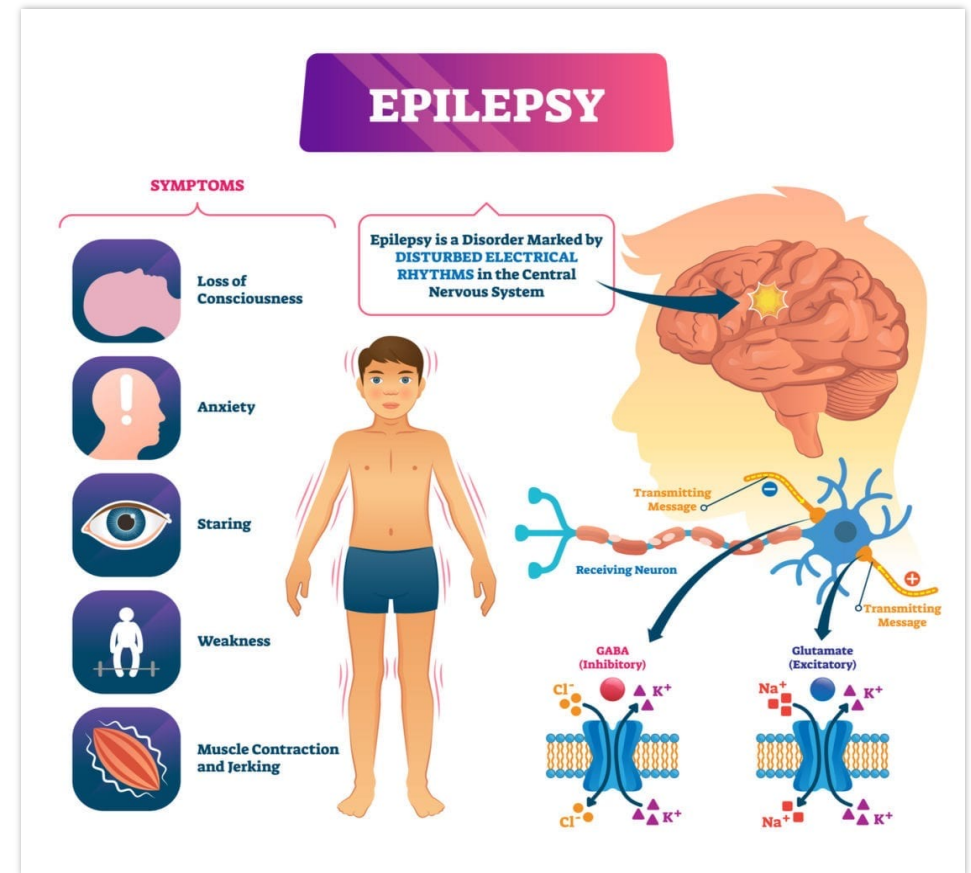


Clinical Settings: EPILEPSY

- Chronic brain disorder

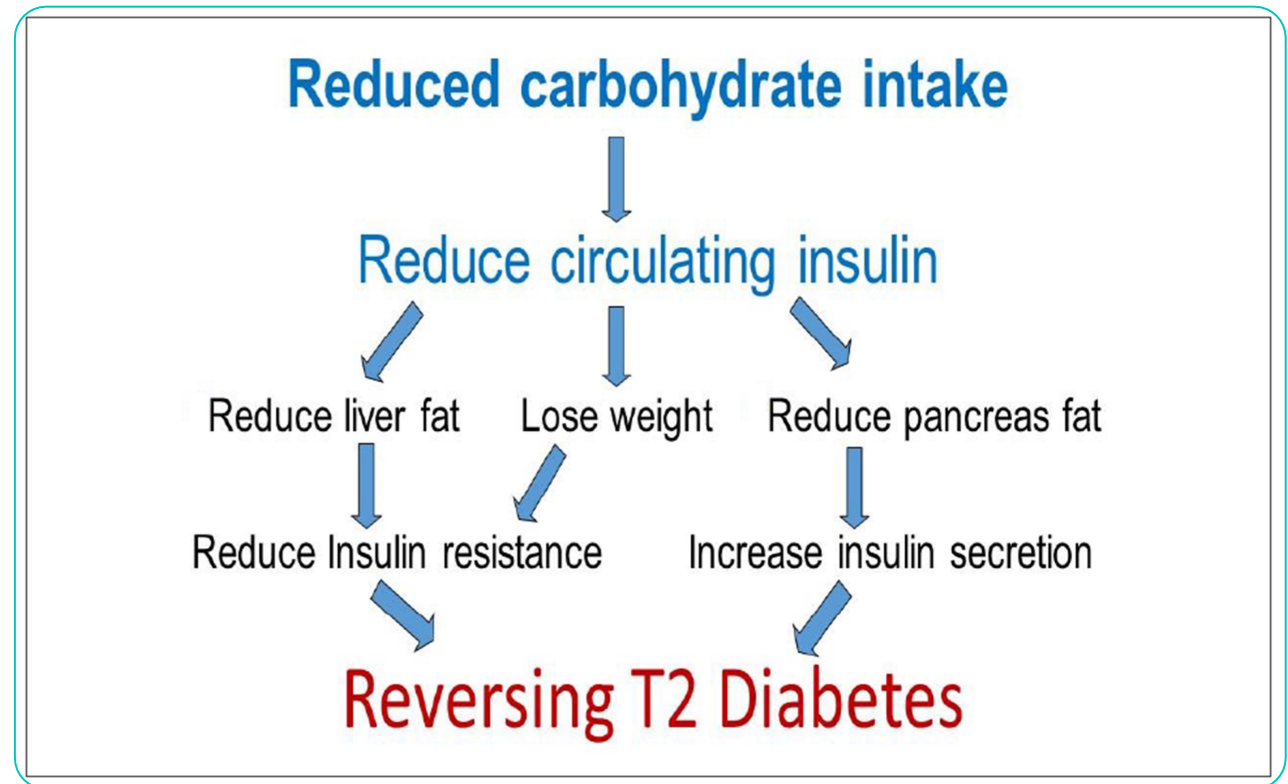
Keto provides ketones that bypass metabolic defects

- Elevated fatty acids and reduced glucose levels.
- Brain tissue becomes more resistant to metabolic stress
- Production of glycolytic ATP
- Various LCHF dietary options.



Clinical Settings: Diabetes

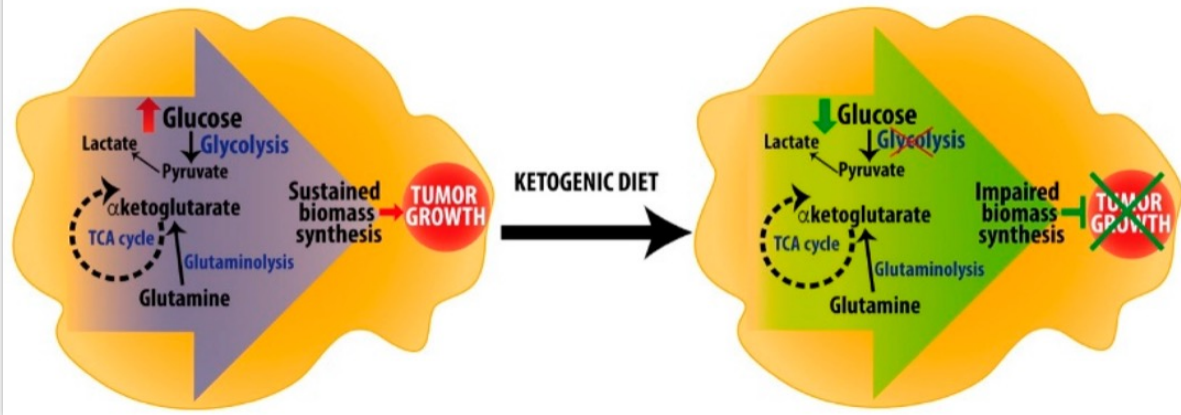
- Carbohydrates convert to sugar increasing blood glucose levels
- Pancreas produces insulin hormone.
- Pancreas starts making glucagon
- Signaling liver to release stored sugar.
- Muscles and other cells stop responding =insulin resistance
- Body is burning sugar not fat
- Risk of obesity/ increased weight



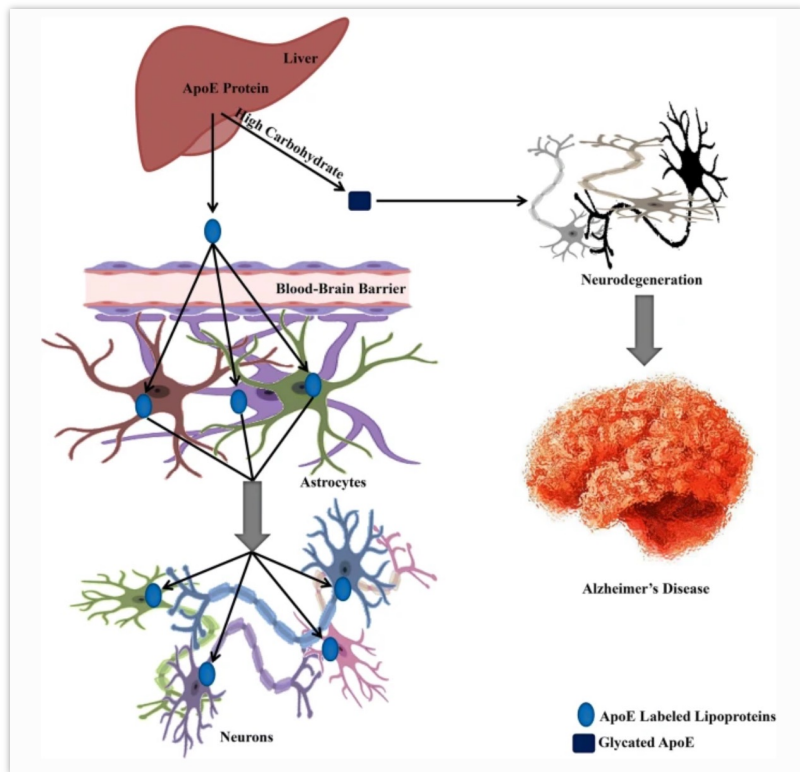
Clinical Settings: Cancers

- Cancer tumours feed on glucose from carbohydrates
- Carbohydrate restriction forces the body to use fat as a fuel source
- Fatty acids are converted to ketones
- Cancer cells are unable to utilise ketones
- Cancer cells are starved, shrink and die

Figure 4. Hypothetical role of ketogenic diet in cancer metabolic rewiring. Cancer cells rely upon metabolic rewiring characterized by increased glucose uptake (red arrow) and glycolysis, increased glutaminolysis and TCA cycle rates, which sustain biomass expansion and tumor growth. Ketogenic diet, by reducing glucose oxidation (green arrow), does not further support cancer cells proliferation, thereby impairing tumor expansion.

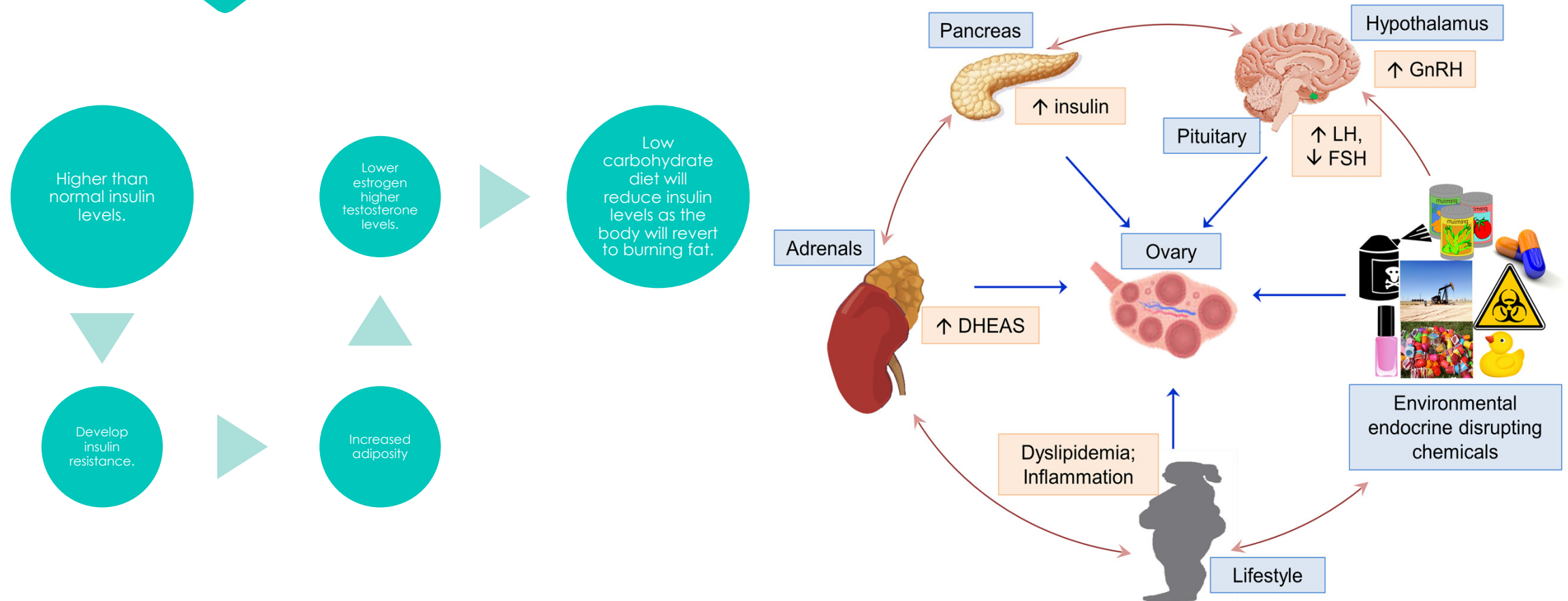


Clinical Settings: Alzheimer's



- New and emerging science is identifying the benefits of a Ketogenic diet on Alzheimer's disease and dementia
- Insulin resistance in the brain is now a significant area of research
- RCT's are discovering the benefits of ketones in reducing both neuro and systematic inflammation in the brain
- Ketogenic diet trials are discovering improvements in cognition, daily function and quality of life for participants with Alzheimer's or dementia diagnoses

Clinical Settings: PCOS



Low Carb Diets for Sports Performance

Low Carb in Endurance Sports

CAN ENDURANCE SPORT BE SUSTAINED ON LCHF DIET???

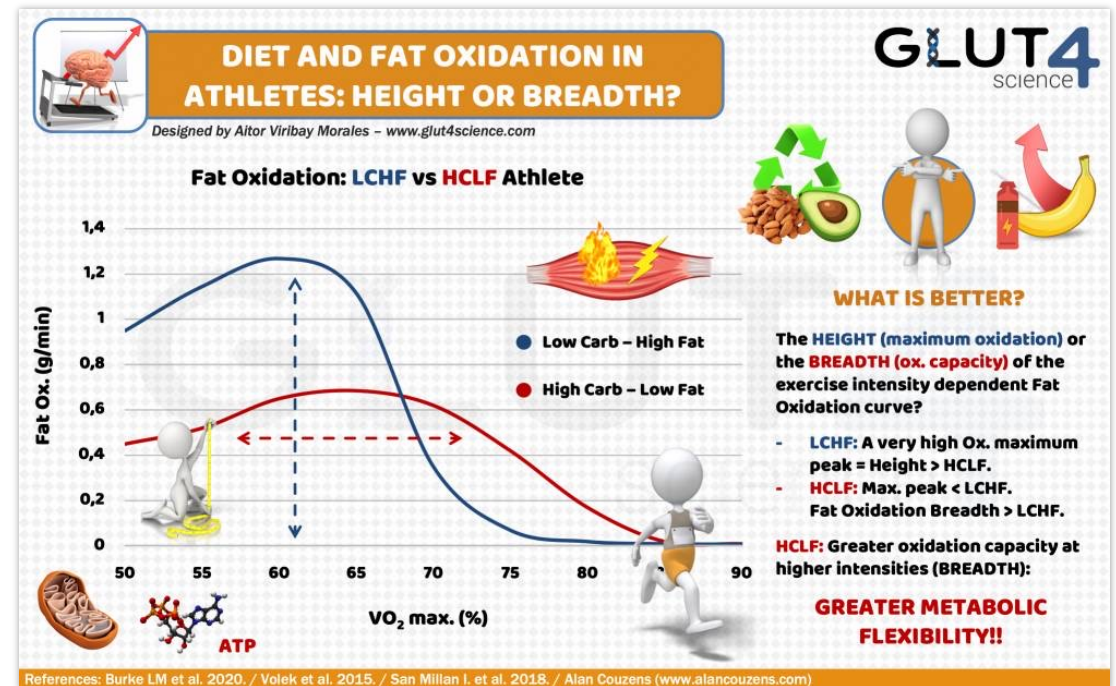
Endurance = $\geq 30\text{min}$ – 4/5hrs (ultra)

Rely on ATP – require carb and lipid fuels.

CHO as fuel for optimal muscle glycogen. Risk of depleting CHO stores.

K-LCHF requires fat oxidation.

Evidence limited performance in high intensity endurance.



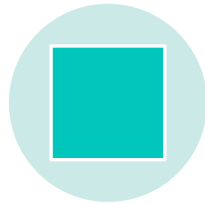
Low Carb in Strength/Power Sports



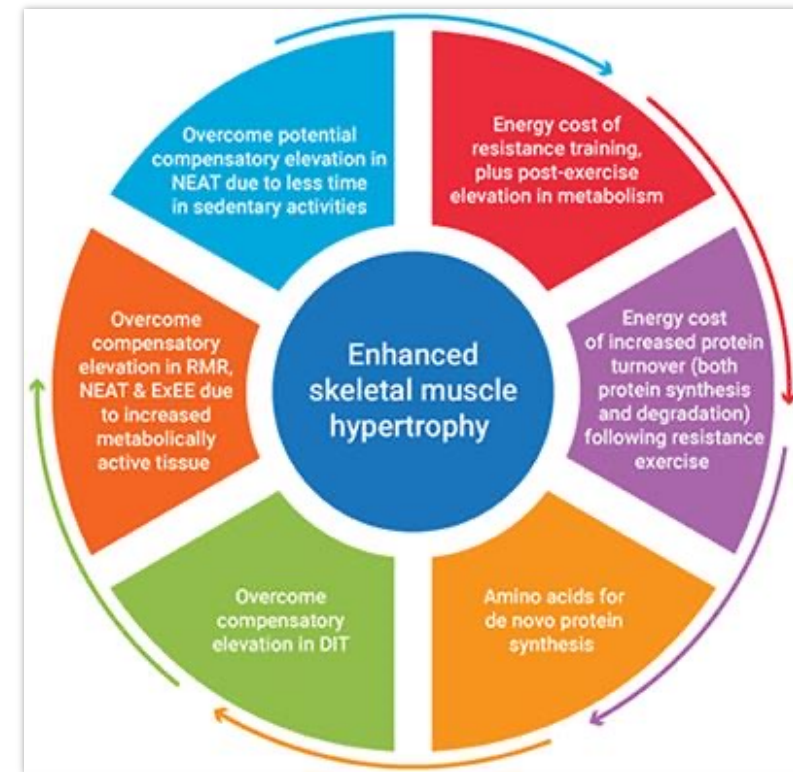
EVIDENCE SUGGESTS
GLYCOGEN
REPLENISHMENT IS
MORE IMPORTANT



SUFFICIENT CALORIE
AND PROTEIN INTAKE IS
NECESSARY RATHER
THAN CARB



EVERYONE ADAPTS
DIFFERENTLY.



Is it Sustainable?

Low Carbohydrate Diets, are they just a fad?

Sustainability: Behaviours and Food Preferences

Disadvantages

- Adherence has proven difficult
- Maintaining motivation to keep meals interesting and variable.
- Changing mentality around foods/meals
- Managing to consume higher calories required.
- Feeling unwell – Keto flu, fatigue and other side effects.

Advantages

- As with all "diets", long term changes to behaviours are required
- Keto diets can become highly restrictive and repetitive meaning motivation needs to remain high to continue
- Low Carbohydrate diets are less restrictive and allow for a greater variety of foods
- Higher protein and fat content means slower digestion and feeling of being fuller for longer
- Stable blood sugar levels staves off hunger resulting from repeated blood sugar highs and lows

Sustainability: Environmental

Advantages

- Diets high in protein can support sustainable, regenerative farming and fishing practices when sourced responsibly
- Traditional, non-factory farm, production is beneficial for regenerative agriculture and supportive of regional biodiversity
- Regenerative farming is carbon neutral, some are carbon negative
- Intensive monocropping is required to support high carbohydrate, plant-based/highly processed diets. These practices are destructive to multiple species and soil structure due to the requirement for fertilisers (nitrogen from fossil fuels), chemical pesticides, insecticides and harvesting equipment, killing everything in their path

Disadvantages

- High meat consumption = Greenhouse gases
- Buying "out of season"
- Food waste (fresh produce)
- Agriculture is no1 cause for deforestation, decreasing biodiversity loss of topsoil
- Water use

Sustainability: Financial

Disadvantages

- High cost of "good quality" ethically sourced/ reared meat.
- Restrictions on diet means eliminating food sectors and producers at a cost to business.
- Upkeep of fresh produce.

Advantages

- Swapping low quality processed foods for high quality, unprocessed foods means a better nutrition profile per £ spent
- Better satiety and reduced appetite means less food is purchased
- Frozen meats/fish/vegetables/fruits are cheaper options and lead to less food waste

Summary

- In healthy bodies, carbohydrates are broken down to glucose which is used for fuel
- Where the body is in a state of insulin resistance, glucose builds up in the blood stream leading to systemic inflammation and damage to nerves and tissue
- Chronically elevated blood glucose and insulin levels result in weight gain, hormonal imbalances, neuroinflammation and feeds tumour cells
- Low carb diets range from <20g (ketogenic) to >120g (paleo) per day
- Low carb diets can be effective for weight loss and improve major health risk markers
- Research also suggests that ketogenic diets are beneficial in Alzheimer's disease and some cancers
- A well considered, low carbohydrate diet can be ethical, sustainable and affordable

Low Carbohydrate Diets

Are they just a fad?

**Thank you for listening
– any questions?**

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