

Low Carbohydrate Diets

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It is appropriate for personal trainers to give guidelines that optimise diet to aid the client's body composition, health, and performance goals, and then refer clients to a nutritionist or dietitian for a more individualised plan. So, an understanding of the current evidence base on the efficacy of low carbohydrate diets for fat loss and metabolic health outcomes is important, hence this review provides a brief summary of current research and some practical tips.

In research, a low carbohydrate diet is defined as one that contributes less than 26% of dietary energy (kilojoules) from carbohydrate foods. There is a wide variation in the absolute grams of carbohydrate per day between individuals that would fall into this category. A person who eats 2000 Calories per day would consume less than approximately 120g of carbohydrate, whereas for someone with an intake closer to 2800 Calories per day, less than 170g of carbohydrate would be considered the threshold for 'low carbohydrate'. As a general rule though, when using absolute amounts, [less than 150g of carbohydrate per day](#) is generally considered a low carbohydrate diet – this is compared to the mean intakes of approximately 207g (females) and 278g (males) per day [currently consumed in New Zealand](#). Clearly, low carbohydrate diets are nothing new, with the [Letter of Corpulence](#) published in 1863 that instructed readers on the dietary approach that successfully shed weight. The restriction of bread, butter, milk, sugar, beer and potatoes were hallmark features of this plan and provided the foundation for subsequent carbohydrate restricted approaches. In the 1970s the low carbohydrate diet approach was popularised by Dr Robert Atkins and the [Atkins Diet Revolution](#). While at the time this was criticised due to the lack of research around its long term safety (and it was directly opposed to the dietary guidelines at the time), it was the start of the modern era of low carbohydrate diets that included the [Scarsdale Diet](#), [Protein Power](#), [South Beach](#) along with updated versions of the Atkins Diet, the latest ([A New Atkins for a New You](#)) being released in 2012. A lack of understanding of these diets has led many health professionals to dismiss them as quackery due to a perceived lack of fibre, vitamins and minerals, despite the relative success that some people experience when following a well formulated low carbohydrate diet.

The percentage calories coming from fat in a low carbohydrate, high fat (LCHF) diet is generally around 50-60% depending on individual variation. This naturally increases the amount of fat coming from both animal and plant sources. A major [argument](#) used by opponents to the LCHF dietary approach is that it promotes unnaturally high levels of saturated fat in the diet and, as saturated fat increases cholesterol in the body, this will clog arteries and lead to cardiovascular disease. There are a number of issues that need to be addressed here. Firstly, dietary fats don't exist in nature in isolation, therefore any food that has a high percentage of calories coming from fat will supply the diet with a range of fatty acids and not one type of fat exclusively. For example, an avocado is predominantly monounsaturated fat but contains not insignificant amounts of both polyunsaturated fat and saturated fat. A well formulated LCHF diet will certainly increase levels of saturated fat in the diet, but will also increase levels of all types of fat.

A major premise of the LCHF plan is not to eat unnaturally large amounts of fat from any one source. Instead it is to include more of the fat naturally occurring in minimally processed foods (such as some dairy products, plants and animal protein). It is certainly true that an increase in saturated fat leads to an increase in total cholesterol for some people [depending on dietary context](#); however the [majority](#) of people see an improvement in their overall lipid profile with the appropriate reduction in carbohydrate as mentioned above.



Author Profile

Mikki graduated with Bachelor of Science in Human Nutrition and a Bachelor of Physical Education from the University of Otago. She attained a Masters in Science (Human Nutrition) with First Class Honours in 2003, focusing on the development of a childhood obesity prevention programme, and obtained a PhD in 2011, completing a thesis in health and productivity in the New Zealand workforce. She has been privately consulting with clients since 2006, and has worked with a vast number of people with different health and performance goals. Mikki is currently working part time as a Senior Lecturer and researcher at AUT University, Auckland, teaching public health and sports performance nutrition. She is part of the Human Potential Centre researching the effects of low carbohydrate, high fat diets on health and performance outcomes for adults, children and athletes.

The role of saturated fat in the development of cardiovascular disease is widely disputed in the scientific literature, and while an increase in saturated fat levels in the blood can lead to an increase in atherosclerosis, these levels are increased with a [higher intake of refined carbohydrate](#) and not a diet that is high in saturated fats. Further, while the original hypothesis that saturated fat increased cholesterol levels which increases heart disease has been what public health nutrition guidelines have been built around, this has simply not borne out in any randomised controlled trials designed to test this hypothesis. In fact, when [comparing the disease outcomes](#) associated with different nutrients, the risk of cardiovascular disease mortality in the US associated with the highest sugar intakes in the USA is 2.75, and in [high GI refined carbohydrates](#) it is 1.98, meaning that women with a high consumption of these foods have almost double the risk of dying from cardiovascular disease. [The association](#) between the highest saturated fat intakes and heart disease incidence was 1.00, or no association at all. Further, dairy fat – the most saturated of all fats – confers health benefits over and above low fat dairy products due to the type of fatty acids present. Research shows a protective effect with regards to [diabetes](#), [cancer](#) and [cardiovascular disease](#), and contribution to obesity.

The premise of a low carbohydrate diet for weight loss is built not on the ‘energy in, energy out’ model of weight loss, but the metabolic fate of carbohydrates in the body. While gram for gram, carbohydrate has less than half the number of calories as fat, it [triggers hormonal effects](#) which can lead to fat storage. When carbohydrates are ingested, they are digested and broken down into glucose and delivered into the bloodstream, resulting in the release of insulin from the pancreas. Insulin is responsible for disposal of glucose into the cells thus returning the blood stream back to its homeostatic level of glucose (of between 4 mmol/L to 8 mmol/L). Insulin also stimulates the production of glycogen in the liver, and when the liver is saturated with glycogen, the glucose is synthesised into fatty acids to travel in lipoproteins into the bloodstream. The glucose that is transported into the fat cells is synthesised into glycerol and used to create triglycerides. For these reasons, insulin is considered to be a major player in fat storage, and carbohydrate is the macronutrient which has a profound effect on insulin secretion. Protein on the other hand, has a minimal effect on insulin secretion (with the exception of whey protein) and fat does not stimulate insulin release. (For more information, [go here](#)). In terms of food, our ability to burn fat if we consume a can of soft drink is compromised compared to consuming two eggs (predominantly fat and protein). This is not to suggest that calories don’t matter, as a calorie deficit still needs to occur for fat loss to be achieved. However, our ability to burn calories stored as fat is far greater when carbohydrate intake is low (as addressed below).

[The research](#) clearly shows that a greater reduction in weight is achieved when following a LCHF diet compared to conventional dietary advice promoting a low fat, calorie-restricted approach. Researchers have studied LCHF diets in both calorie-restricted and ad-libitum conditions (where participants could eat as much food as they like), and weight loss was greater in the LCHF group. When it came to dietary adherence, as measured by trial completion, low carbohydrate diets achieved better adherence than low fat (i.e., 79.5% vs. 77.7%, respectively). While the difference is marginal, it still indicates from these studies that LCHF diets are at the very least not harder to stick to than other diets. A possible reason for this might be that these diets appear to [reduce hunger](#) and participants are permitted to eat until satiated. While people argue that diets high in both fat OR sugar will result in increased energy intake and weight gain, the results of the above studies illustrate the opposite. A low carbohydrate diet may normalise energy intake due to the higher satiety of fat, and this isn’t typically seen in a higher carbohydrate, lower fat approach. In relation to health outcomes, the LCHF diets outperform standard practice guidelines when it comes to [lipids, HDL cholesterol and triglycerides](#), and have similar beneficial outcomes with glycaemic control and blood pressure. There appear to be [no serious adverse effects](#) arising from either of the dietary protocols, thereby assuring safety from both. Importantly, in the studies where abdominal fat was measured (which is an independent risk factor for cardiovascular disease), LCHF groups have a [clear advantage](#) over low fat diets.

[A LCHF diet has its benefits for athletes](#), and utilising fat as a fuel source is advantageous from an endurance sport perspective where performance can be limited by the amount of carbohydrate able to be ingested throughout events greater than 2+ hours. The goal of becoming efficient at burning fat as a fuel source is to enable the athlete to become metabolically flexible (i.e. to be able to burn either fat or carbohydrate) during both training and racing as the intensity of the effort requires it. An athlete who has a high carbohydrate diet is less able to tap into fat stores if their body hasn’t had a chance to adapt to a lower carbohydrate diet, and upregulating the fatty acid pathways in the body helps delay the use of stored glycogen which is beneficial for endurance events. Further, the ability to utilise fat as a fuel source allows for improvements in body composition as less exogenous fuel sources need to be ingested. This also helps reduce the incidence of gastrointestinal issues experienced by many endurance athletes in both training and racing who cannot take in enough carbohydrate to fuel the demands. While it is argued that a low carbohydrate approach to diet is detrimental to an athlete’s performance, when timing carbohydrate intake to meet recovery needs, and when given adequate time for the energy system to change from burning predominantly carbohydrate to burning predominantly fat, most athletes benefit from a LCHF diet. The length of time to adapt is individual, however, and anecdotal reports suggest it can take anywhere from 4-12 weeks in the first instance.

Therefore changes to a diet should take place during off season or when an athlete is building base endurance for their event, and not in a period of high intensity training. While the application of an LCHF diet is obvious for an endurance athlete, a lower carbohydrate, higher fat diet may be beneficial for [other athletes](#) participating in shorter events of higher intensity or team sport athletes. The timing of carbohydrate intake to fuel glycolytic activity and maximise recovery needs to be addressed, and working with a sports nutritionist or dietitian is required for more specialised advice.

One of the main criticisms of a low carbohydrate approach is that carbohydrate is an essential nutrient and cutting this out leads to a reduction in optimal functioning. A nutrient is defined as essential when we can't produce it in our body and therefore it must be supplied by our diet. As we have a limited storage capacity for carbohydrate (approximately 400-500g depending on muscle mass), this has led to the misconception that we require daily replenishment. Unlike fat and protein, however, our body is very adept at producing glucose through a process known as gluconeogenesis; the production of glucose from both fatty acids and amino acids. We produce roughly [120-140g of glucose per day](#) independent of food intake.

A second criticism of a LCHF diet is that the exclusion of food groups (specifically whole grain cereals) leads to a deficit in nutrients. However, a well formulated low carbohydrate diet can be far more efficacious at supplying all nutrients when compared to conventional weight loss dietary advice which is based on providing a low fat diet that is rich in whole grains. In actual fact, very little food sources contain the whole grains that confer actual health benefits and in New Zealand true wholegrains such as pearl barley, brown rice, and pumpernickel bread are not common items of our dietary intake. Most wholegrain breads are made with white flour and other refined additives (they are in fact highly processed foods). The grinding of wholegrains to make flour produces a high-GI carbohydrate. The consumers most convenient guide to what is wholegrain and what is not comes from packaging claims which are more or less misleading. Furthermore, attempts to comply with this recommendation in institutional kitchens often results in the addition of bran to refined grains. A [recent meta-analysis](#) has concluded that the health benefits of a diet high in wholegrains could be overstated, and the suggested benefits observed in epidemiological studies are not supported by the clinical trials. In addition, there is increasing prevalence of maladaptive immune responses to proteins of various grains and legumes in a significant proportion of the population. The rate of coeliac disease, while acknowledged as a small population prevalence, is [highest in the cultures](#) that eat the largest proportion of diet as wheat. The increasing recognition of sub-optimal health related to [non-coeliac gluten sensitivity](#) – including allergies, headaches, gastro-intestinal problems and fatigue – suggest that reducing wheat-based carbohydrate in the diet for many could be beneficial. Phytic acid, which is found in high levels in unrefined grains, binds to minerals, rendering them insoluble, and is [linked to deficiencies](#) of iron, zinc, magnesium and calcium.

The third major criticism of a LCHF diet is that it leads to ketosis which is a dangerous metabolic state to be in. We are able to burn both glucose and ketones as a fuel source, however given the modern diet, most people preferentially burn glucose. Nutritional ketosis is a state whereby the body burns ketones as opposed to glucose as a fuel source. Ketones are produced from the breakdown of fatty acids and amino acids, of which there are three types: acetone, acetate and betahydroxybutyrate (BOHB). This survival mechanism likely provided humans with a metabolic advantage in prehistoric times when food was scarce and we went for a period of time without fuel. The limited storage capacity for carbohydrate requires an alternative fuel source for the brain (first and foremost) and the ketone bodies produced through ketosis provides these. Nutritional ketosis is when ketone (BOHB) production measured through the blood is around above 0.5mmol/L, with the ideal spot (to confer mental acuity benefits) [said to be between 1-3 mmol/L](#). This state of nutritional ketosis is confused with [diabetic ketoacidosis](#), a serious health condition due to uncontrolled ketone build up in the blood. This comes from the inability to take glucose into the cells in people who aren't able to produce insulin (typically people with type 1 diabetes). The body recognises this as a fasting state and effectively starts to produce ketones for an alternative fuel source, however there is no ability to clear either ketones or glucose without the provision of insulin and instead the rapid rise in ketones (to levels above 10 mmol/L) can lead to serious metabolic conditions. This is as a result of a low pH level of the blood that can result in nausea, vomiting and unconsciousness. This state is, however, impossible for anyone who can produce insulin as the body has a feedback loop which enables the clearance of glucose and ketones from the bloodstream.

Importantly, the level of carbohydrate in the diet required to achieve ketosis is less than 50g per day and, for many, closer to 30g per day. Protein levels also have to be closely monitored due to gluconeogenesis. So, while a low carbohydrate diet can lead to ketosis, this isn't an inevitable part of embarking on a low carbohydrate diet, and nor is it a requirement for being able to use fat as a primary fuel source. There are many pathways in the body that allow us to use fat as an energy substrate. This includes upregulating lipolysis (the breakdown of fat stores into fatty acids and triglycerides to be used by the muscle as energy); the upregulation of beta oxidation which increases the conversion of fatty acids to acetyl coA (the precursor for the Krebs cycles to produce ATP) and the increase in gluconeogenesis (the conversion of protein and fat to glucose) are all pathways that can aid in fat burning that don't require a ketogenic diet and instead can be enhanced through following a well formulated LCHF diet.

Finally, people mistakenly assume that a low carbohydrate diet must be high in protein and that this is both expensive and unsafe. As mentioned above, a well formulated LCHF diet contains a moderate amount of protein, with the remaining calories coming from fat. In the literature the percentage energy coming from protein is typically in line with standard recommendations for protein intake (between 15-25%). It is also worth mentioning that a higher protein intake is not associated with adverse health outcomes in people who are healthy; those with impairments to their kidneys do need to monitor protein consumption as the kidneys are the organ responsible for processing protein load in the body. For most people this is not a concern.

In summary, while there certainly isn't one diet to suit every individual, a well formulated LCHF dietary approach is beneficial for metabolic, health and sports related outcomes. When designed to optimise nutrient quality, the similarities between this and a 'paleo', 'whole food' or 'clean eating' approach far outweigh the differences.

Practical tips:

- A low carbohydrate, high fat diet (LCHF) is one which the calories from carbohydrate are approximately 25% or less in the dietary intake, and typically below 150g per day in absolute amounts.
- The premise of a well formulated LCHF diet is one which is based around food quality and consuming food as close to its natural form as possible.
- Build meals around an abundance of non-starchy vegetables of all colours.
- The carbohydrate foods consumed on a well-formulated LCHF diet come a small amount of starchy vegetables and legumes, low sugar fruit and full fat dairy products.
- Incorporate moderate amounts of animal protein, fish and eggs for quality protein sources in a meal.
- Fats such as butter, coconut oil, lard and olive oil are best to cook with, and other nut oils can be used as dressing for salads. Include avocado, raw nuts and seeds as high fat options in meals and snacks.
- Processed or highly refined foods, oils and margarines or spreads are best avoided.
- Incorporating fat and protein in every meal or snack will help minimise blood sugar swings and improve glycaemic control across the day.

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