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Research Digest

Exclusive Sneak Peek

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Table of Contents

INTERVIEW:

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Ketogenic diets (whether of the cyclical, targeted, or sustained variety) have tended to be used in niche cases during the past couple decades. But through Reddit and other avenues, you've been popularizing keto for the masses. How did you come to this point?

I have always been passionate about fitness due to a personal interest in improving my own physique (I used to be the quintessential fat kid in school).

I like to learn the "whys and the how's" of things, and so one of the main reasons that got me into nutrition and fitness in the first place, and eventually led me to found Ketogains, was to differentiate between sound, science based information, and "old wives' tales" or what is usually referred as "bro'science":

I started Ketogains "officially" over 5 years ago, (despite having been practicing a ketogenic approach since 2001), after becoming dissatisfied with the overwhelming amount of misinformation shared among fitness and low carbohydrate internet forums: sometimes inaccurate, sometimes contradictory, and most of the time, just plain wrong, based solely on anecdotes or misunderstood science taken out of context.

It was the usual "it works for me" answer that irked me the most: people that used the catchphrase as a response when I tried to explain why their current approach might not be the optimal for their goals.

Due to this, I started to write a comprehensive "Evidence Based" Wiki in Reddit (r/ketogains) which would serve as a guide to help people learn more about a Ketogenic Diet in general, as well as its fitness applications.

The site grew from a "FAQ" with a collection of studies and resources, to a full-fledged forum where I was helping people with training, macros and diet advice.

Over time, people started to see great results, and the word spread out.

Currently we have a super active Facebook group with over 50k members which has now outgrown Reddit (at 40k members) and a webpage (ketogains.com)

I believe part of the success of Ketogains has been, first and foremost, that we are firmly grounded in science, that we are able to translate this science into easily understandable advice that will resonate with people, and that we use a "no BS" approach, where we "say it like it its", objectively, without bias or emotions.

The Ketogains approach is "Educate, Empower, Achieve" – We believe in teaching people the tools that will help them take control of their diet and fitness.

People have so many misconceptions about keto dieting, whether it's "must be so much protein!" or something else. What do you actually eat, compared to what people assume you eat? And what are your macros like?
When most people think of a ketogenic diet, they often envision a person eating a loads of bacon, eating the so called "fat bombs" and drinking buttered coffee all day long.

In reality, my everyday diet is more akin to what a person who is "health conscious" would normally eat:

A typical day for me is 3-4 eggs, animal sources of protein (chicken, turkey, tuna, sardines, salmon, beef or pork), I prefer green vegetables (spinach, zucchini, broccoli, cauliflower, chayote squash) although I will also eat mushrooms, tomato, etc. with moderation; and for fats I can add avocado, coconut or olive oils (just enough to cook). I don't eat cheese or butter on a daily basis, save for Cottage cheese.

As you see, I don't add "globs" of fat to my diet, and I don't really limit much my vegetable intake: green vegetables are quite rich in vitamins and minerals, as well as fiber, which makes them naturally low in NET carbohydrates.

I follow a "nutrient density" approach to food, where I favor whole foods – although I'm not 100% paleo and will also eat / drink processed items such as diet coke on occasion.

I like to maintain a "lean" physique all year round, as per my stats (5'6", 167.5 lbs, at around 10% BF) I aim for 145g of protein, 30 to 40g NET carbohydrates, and fat intake depends on my energy levels and goals: between 70 to 140g a day.

I also Intermittent Fast, eating 1-2 times a day, following a Leangains protocol.

What are some common problems that first-time keto dieters stumble into?

"When most people think of a ketogenic diet, they often envision a person eating a loads of bacon, eating the so called "fat bombs" and drinking buttered coffee all day long."

The main issue I see with everyone who starts following a Ketogenic Diet (in any of its variations) is downplaying the importance of electrolytes, mainly sodium.

As we know, Ketogenic diets are diuretic in nature, especially during the adaptation process (a ketogenic diet lowers insulin levels and increases insulin sensitivity. Normally, the kidneys tend to store and reuse sodium under normal conditions. When insulin levels are low and stable, kidneys through various hormonal mechanisms go into a diuretic mode, excreting sodium, potassium and water).

Because most people come from a diet high in processed food (which is usually high in sodium), and paired with most countries current sodium guidelines where people are told to limit their salt intake; people are either reluctant or dismissive to increase sodium when starting a ketogenic diet.

This causes a host of symptoms commonly known as the "Keto Flu": dizziness, headaches, fatigue, lethargy, cramps, irregular heartbeats.

People get scared and think they "need" carbohydrates, and go back to eating them, which in turn "cures them" but also stops ketosis.

This "keto flu" can be either prevented or eliminated by supplementing throughout the day with sodium (5g), potassium (1g) and magnesium (300 mg) – as per Lyle McDonald's suggestions in the "Ketogenic Diet" book; additionally, I would suggest an extra 1-2g of sodium before training, just as Dr Phinney and Volek suggest and which I encourage as well.

You're a good case study for sustained ketogenic dieting supporting a bodybuilding regimen. On the endurance side, there are also many good case studies. But competitive athletes want every edge they can get. Drs. Phinney and Volek have provided some evidence on the "pro-keto" side, whereas recent research has looked at the opposite side. Do you have a view on keto for endurance?

As you know, I favor more so strength based sports (I practice both bodybuilding and powerlifting) which in both my personal experience, as well as with clients, seems to work quite well for ketogenic dieters – with some adaptations, of course, mainly being adequate electrolyte intake and in some cases pre-workout carbs a la TKD (Targeted Ketogenic Diet).

Said this, I also know quite a few athletes and researchers that are actively experimenting with the endurance side of low carb, mainly Peter A. Defty who has collaborated with Steven Phinney in the FASTER study.

In this special case, I think we are seeing very promising results, but we still need more information, the actual science on low carb performance is very much still in its infancy. ***I hope as more research comes along that we can get a more definite answer on who should do a low carb approach, when, and how.***

I would like to address as well, an issue that seems to usually pop up in fitness conversations: we have people who "hate" on keto, saying that it is useless for sports performance, and then we have the keto-fanatics that tend to exaggerate and attribute the diet magical properties.

I'm not going to get into much detail into the usual discussion points (regarding, that some believe calories do not matter, that one can eat as much as one wants and will still lose weight, etc. – which for the record, I do not believe: energy balance is key), but I will say this:

In regards to sports performance, I agree that carbohydrates have a positive effect in performance, there is no way of denying that… however, the real question would be, "how many" does one actually need.

When speaking about needing carbs for optimal sports performance, trainers / researchers usually speak in "absolutes" and their target audience is not usually well versed in applying context.

Of course an Olympic-level athlete will need an incredible amount of carbohydrates to sustain his training and recover properly.

But, we forget that most people are not Olympic level athletes. An overweight person, the classical "weekend warrior" that does Crossfit 3 days a week for 1 hour, will never need the same amount of carbohydrates than Rich Fronnig, yet everywhere he looks, he gets the message that he actually "needs" all the carbohydrates to perform.

If you were to look at the person's diet, most of the time one would find that he is already consuming more carbohydrates (as well as probably fat) than he actually needs. Very likely, what would improve more his performance, is reducing his body fat intake with proper diet, for which a well formulated ketogenic diet can be one of many other options to follow.

So the message I want to convey here, is that not all people are going to be top level athletes, and that for the type of training most people are going to be doing (save some sports that indeed are more glycolytic), a well formulated ketogenic diet can help them perform well.

And then, we must remember that one can also modify the diet as to include more carbs around training (there are some very metabolically flexible people that will still be in ketosis with 100g carbs a day). A ketogenic diet for sports should be a flexible, not a rigid approach.

I always say "Earn your carbs".

Do you take any supplements? Like MCT oil, nutrients, performance-related supplements, etc.?
I am a big advocate of "whole foods", but also think supplements have a place, as to increase performance, recovery, or strength.

As a pre-workout, I normally ingest what I call the "Ketogains Coffee" which is basically Strong coffee (and I add a caffeine pill, 200 mg), with MCT Oil (either the Oil or in Powder form, or one could substitute with Coconut Oil, although we know it's not as effective due not being "pure" MCT), Creatine (the usual 5g); 1 to 2g of sodium (in the form of sea salt), and 5 to 10g dextrose.

This is because I follow a TKD (Targeted Ketogenic Diet) approach. I use the dextrose as to rise a bit my blood glucose levels, and have more insulin around training as to inhibit protein breakdown.

I will also add on some occasions, extra Protein in the form of a Whey shake (for MPS) to the coffee, as well as Citrulline Malate (6g) as to help with recovery / fatigue.

> "A ketogenic diet for sports should be a flexible, not a rigid approach.
>
> I always say "Earn your carbs"."

Outside this Pre-Workout; I like to experiment every now and then with new or promising supplements or stacks, for example, Ketone Salts / Esters (which I do find they seem to help a bit with strength).

I also use Vitamin D on a daily basis.

What is a keto-related research question that you'd like to see answered, which has insufficient research right now?
I would love to see more research into the actual energy needs between individuals who are starting a ketogenic diet, vs those who are fairly well adapted.

We have all read about some cases on which individuals when starting a ketogenic diet, lose body fat at quite fast rates, even when in theory / reality consuming way past their calculated RMR/TDEE.

On the other hand, there are some people on the other side of the spectrum, which thrive on seemingly lower calories.

I have been talking about this with quite a few brilliant minds in the low carb community, and there are some interesting takes on this, mainly, a theory that may point towards substrate efficiency:

First, your body does not know how to effectively use all this "new" source of energy that it is not accustomed to, so it seems plausible it will be "wasted away"

Over time, as a well-oiled machine, it will fine tune itself and learn to use this energy better, and more effectively, thus reducing waste: not an actual metabolic "downregulation", but rather, a metabolic efficiency (In my mind, it seems to make sense).

I have seen this on myself, as I function perfectly at ~1,900 kcals or so (my stats are 5'6" - 167cm; 167.5 lbs -76kg; 10% BF) ... even with arduous strength training sessions, yet my calculated RMR is ~2,600 kcals...

Also, Alessandro Ferreti is currently doing research on the subject. ◆

Luis founded Ketogains over 5 years ago, (despite having been following a ketogenic diet since 2001), after becoming dissatisfied with the overwhelming misinformation advice given in various low carb forums & groups based solely on anecdotes.

His objective, evidence based approach has garnered him a special place among some the most serious, experienced and knowledgeable persons on Low Carb / Ketogenic dieting, and is the “go to guy” when applying a Low Carb diet for Bodybuilding and Strength Training.

Luis has obtained a variety of fitness and nutrition credentials, and is also a sponsored athlete.

Are ketogenic diets beneficial to the fitness and fatness of healthy adults?

A before and after comparison study to examine the effects of a ketogenic diet on physical fitness, body composition, and biochemical parameters in healthy adults.

Introduction

The late 1970s marked the beginning of the obesity epidemic: U.S. obesity rates went from increasing gradually to exponentially over the course of the next two decades. Coincidently, this rise was accompanied by recommendations to limit the consumption of total dietary fat to avoid heart disease and other ailments. For a long time the USDA food pyramid dictated that carbohydrates (whole grains) should be dietary staples, the Surgeon General recommended that Americans reduce their consumption of foods high in fat, and the National Institute of Health (NIH, 1984) suggested that Americans cut their saturated fat consumption. The overall consensus amongst the American population was that eating fat made you fat.

In recent years the tables have turned and low carbohydrate diets have become a popularized means to induce weight loss. Support behind ketogenic and low carbohydrate diets have been further strengthened by studies demonstrating that carbohydrate restriction can be effective at promoting fat loss. Additionally, ketogenic diets (<10% calories from carbohydrates and >60% of calories from fat) have been shown to be beneficial for decreasing side effects of diseases like epilepsy, and may show some promise in conditions including polycystic ovary syndrome, neurodegenerative diseases, diabetes, and cancer. Despite the growing use of ketogenic diets amongst various disease populations, insufficient evidence exists in non-athletes and athletes to support that ketogenic diets do not negatively impact aerobic and physical performance in healthy individuals.

In the reviewed study, the authors set out to address this research gap by determining the impact of an *ad libitum* (without caloric restriction), 6-week, ketogenic diet on physical performance, body composition, and blood parameters in healthy adults.

For years, the idea that high fat, low carbohydrate, diets could be beneficial was contested. Although data exists suggesting that ketogenic diets are beneficial for weight loss and certain diseases, there is limited evidence elucidating their effects on physical performance and daily activity. In this study, researchers investigated how 6 weeks of a calorically unrestricted ketogenic diet impacted physical performance, body composition, and blood parameters in healthy men and women.

Who and what was studied?

Researchers in Germany recently published a before and after comparison study, in which the effects of a six-week ketogenic diet on body composition, physical performance, and biochemical measures were assessed in a group of 42 men and women. In this study, participants could eat as they pleased, so long as they adhered to the principles of a ketogenic diet and would thus consume no more than 10% of daily calories coming from carbohydrates, 75% coming from fat, and 15-20% from protein. To track the subjects' adherence to the diet, urinary ketones were tested daily and seven-day food logs were maintained.

The study population parameters included male and female participants between the ages of 24 and 63, with BMIs ranging from normal to overweight (19.0-30.4 kg/m2). The study had a slight gender bias, as over 73% of the participants were women. The participants included a range of sedentary to vigorously active individuals. Individuals who were excluded from the study included those already on low carb diets, those that had impaired renal or kidney function, those that were pregnant or lactating, or those that had diabetes.

All participants who completed the study underwent a preparation period, during which they received group and individualized instruction from a dietitian, educa-

tional ketogenic diet handouts, and recipes so that they could maintain a ketogenic diet according to their food preferences. To aid the transition to a ketogenic diet, all participants were advised to gradually shift their diets so that by the end of the first week they could be in stable ketosis with minimal side effects. Participants were also asked to log daily side effects and complaints. Throughout the study, participants were advised to continue their normal activity routine, and their adherence to this request was monitored using a questionnaire. When needed, a dietitian was available by phone or in person to help participants maintain ketosis throughout the study. Additionally, photographic estimates and food scales were used to help improve the details included in their seven-day food logs.

To test the hypothesis that six weeks of a ketogenic diet would influence biochemical parameters, body composition, and physical fitness in the general population, each participant's baseline metabolism, blood parameters, physical performance, and body composition were assessed prior to (pre-test) and following (post-test) the intervention. Body composition (fat-free mass, fat mass) was measured using a BodPod and additional fat-mass, fat-free mass, and body cell mass measurements were taken using a bioelectrical impedance device. Respiratory exchange ratio, a measure that is indicative of the ratio of carbohydrates to fat used to fuel the metabolism, was measured to estimate baseline metabolism and calculate resting energy expenditure. Baseline echocardiograms were recorded at this time.

For their primary measurement of physical performance, a maximal incremental cycling test was used to measure aerobic capacity. Relative and absolute peak oxygen uptake (VO_{2peak}, shown in Figure 1) were the primary testing measurements; with ventilatory threshold, peak power, maximum heart rate, and maximum respiratory exchange ratio severing as secondary measurements . Isometric muscle strength was also measured using an

Figure 1: How to measure VO_2

1 – A mask is worn to help measure the amount of oxygen inhaled and exhaled.

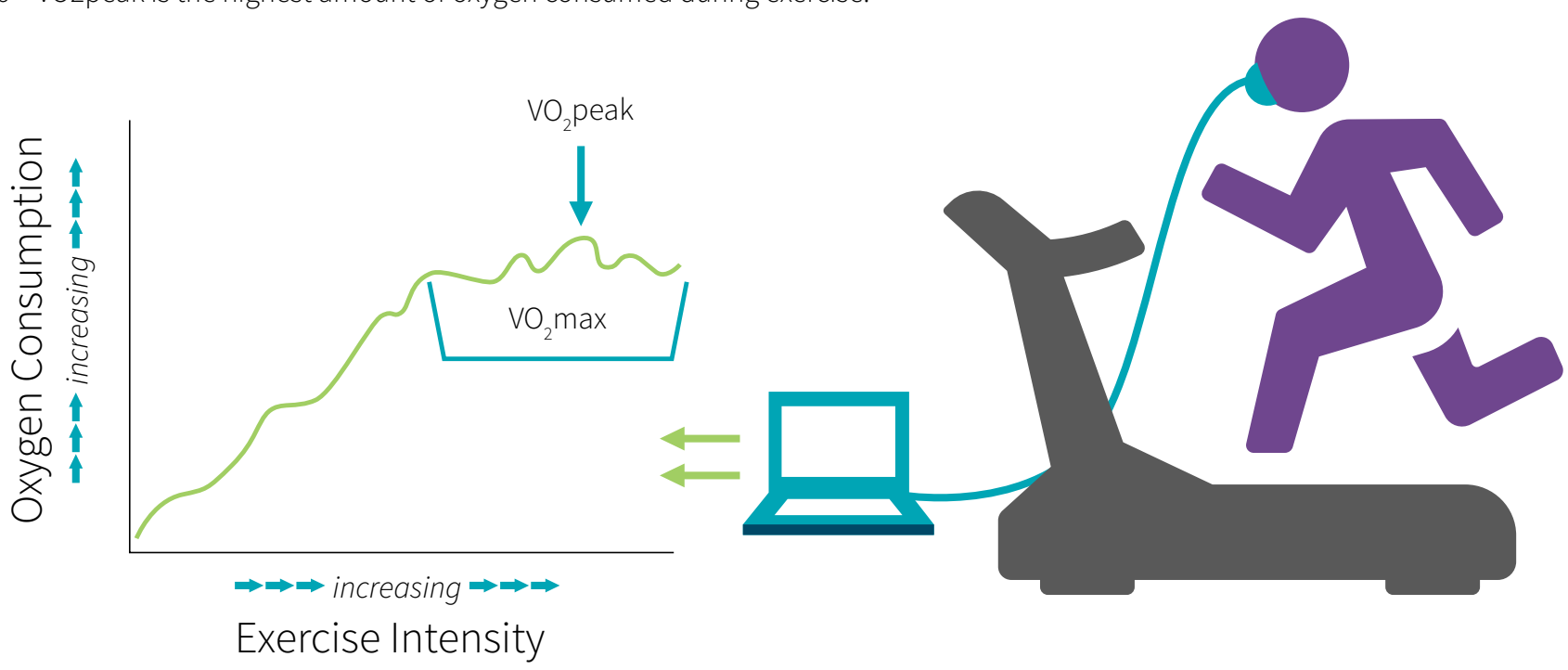
2 – The test is usually conducted on a treadmill or bike that increases in speed or resistance at regular intervals.

3 – As exercise intensity increases, the amount of oxygen exhaled decreases as your cells begin to use more of it.

4 – VO2max is reached when oxygen consumption reaches a maximum and plateaus, beyond which no increase can be achieved.

5 – A typical VO2max ranges between 30 and 60 ml of oxygen, per kilogram of body weight, per minute (O2/kg/min)

6 – VO2peak is the highest amount of oxygen consumed during exercise.



electronic hand dynamometer as a secondary physical performance outcome measurement.

The body composition, physical fitness, and blood parameters of 42 healthy men and women was assessed pre and post six weeks of *ad-libitum* ketogenic dieting to predict the effect of a ketogenic diet on the general population. A graded maximal exercise test and isometric grip strength test were used to measure physical performance. Additionally, biochemical laboratory tests, plethysmograph (BodPod), and bioelectrical impedance analysis (BIA) were used to track changes in blood parameters and body composition.

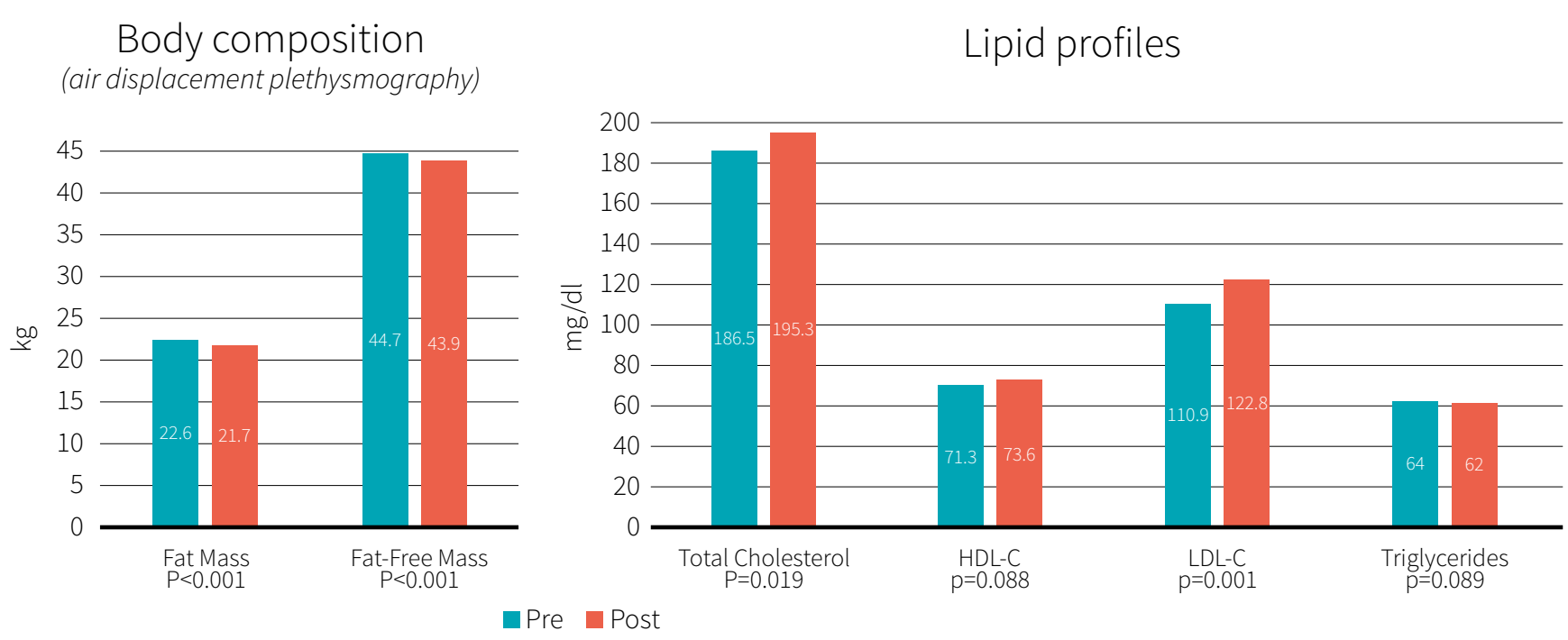
What were the findings?

At the conclusion of the six-week intervention, there was a 97% adherence rate amongst the 42 of 46 subjects that completed the study. Four participants dropped out due to gastrointestinal issues, difficulty maintaining the diet, external health issues, and persistent headaches. Of those that completed the study, there was a significant decrease in participants' respiratory exchange ratio from 0.86 (which is indicative of about 47% of fuel coming from fat oxidation, and 53% coming from carbohydrate oxidation) to 0.79. This change indicated that participants had shifted to increased utilization of fat oxidation for fuel. Participants also had a significant decrease in resting energy expenditure by nearly 100 kcal/day, which was somewhat surprising considering that the participants lost a significant amount of weight (70 to 68.4 kilograms), without significant changes in daily caloric intake or physical activity.

As shown in Figure 2, BodPod measurements found a decrease in both the subjects' fat (22.6 to 21.7 kilograms) and fat-free (44.7 to 43.9 kilograms) mass.

In terms of physical fitness, the ketogenic diet resulted in a significant decrease in absolute VO_{2peak} (2.4% decrease), peak power (Pmax, 4.1% decrease), and perceived exertion during the maximal cycling test. VO_{2peak} is a measure of how fast oxygen can be delivered to working muscles, and since larger bodies require more oxygen to be transported for a given VO_{2peak}, the value is often normalized to body weight. When normalized to body weight, the ketogenic diet had no effect on relative VO_{2peak}. Spinning speed, maximum heart rate max, and ventilatory threshold were unchanged. Muscle strength, as measured with the isometric handgrip test, was significantly increased (2.5%). Additionally, there was an increase in resting heart rate by two beats per minute.

Figure 2: Study results



Subjective questionnaires revealed that participants reported feelings of decreased hunger and reduced physical fitness. Although more than 70% of participants reported no effect on endurance capacity, roughly a third complained of decreased strength and power. Nearly all felt the diet had no effect on their daily activity. Over 85% of participants mentioned they would consider using a ketogenic diet in the future.

The analysis of the seven-day food logs showed that the overall caloric intake was unchanged from pre to post intervention. An expected increase in dietary fat and protein intake at the expense of carbs was also observed. Participants had a significant decrease in alcohol and fiber intake. From a micronutrient standpoint, fat and fat-soluble vitamin intake increased across the board and there was a decrease in the intake of most minerals and trace elements.

From a hormonal and biochemical perspective, the six-week ketogenic diet resulted in decreased blood glucose levels and increased LDL and total cholesterol levels. Effects on blood counts were minimal, with only the platelet number significantly reduced. Most biochemical changes were observed in the hormonal levels of participants at the end of the intervention. Free T3, insulin and IGF-1 were reduced, whereas free T4 increased. Similar to the micronutrient analysis from the food logs, there were decreases in blood iron and folic acid levels.

Six weeks of ketogenic dieting in healthy individuals resulted in decreases in fat mass and weight, in the apparent absence of changes in caloric intake and physical activity. Differences in aerobic performance included decreased absolute VO_{2peak} and power, but there was no change in relative VO_{2peak}. Additionally, hand strength improved. Hormones involved in controlling muscle growth (insulin, IGF-1) and metabolism (free T3) were decreased, as was resting metabolic rate.

What does the study really tell us?

The underlying goal of this study was to identify how 6 weeks of *ad libitum* ketogenic dieting would affect the physical performance, body composition, and blood parameters of healthy individuals who represented the general population. Before interpreting the results, we must first consider the study design. This study was a pre-post study; this means subjects' fitness, body composition, and health parameters were compared before and after the intervention.

> "[...] since there was no such group, the study could not control for other potentially confounding elements, unrelated to the ketogenic diet, that occurred during the testing period."

The benefit of this design is that it reduces variation between subjects within the before and after mean measurements, since the paired observations are dependent. If the reviewed study had included a no-intervention arm (control group), the findings from the pre versus post tests could have suggested that the ketogenic diet was driving the observed outcomes. However, since there was no such group, the study could not control for other potentially confounding elements, unrelated to the ketogenic diet, that occurred during the testing period. This is a serious limitation, as participants in studies may change a variety of behaviors simply due to being enrolled in study.

The results are reported in a way that makes a ketogenic diet appear to have a somewhat negative effect on their main performance measure: the graded maximal exercise test. The diet did induce a significant decrease in absolute VO_{2peak}; however, once adjusted for body weight, VO_{2peak} was unaffected. VO_{2peak} measures the maximum amount of oxygen consumed per minute. Considering that the transport and use of oxygen throughout the body is heavily influenced by the amount of body mass a person has, it is regularly normalized to the maximal amount of oxygen consumed per minute per kilogram of bodyweight. Whereas muscle is the main user of O_2 during a maximal test, measuring VO_2 relative to body weight is more indicative of performance than measuring the absolute value.

In terms of body composition, the authors reported a modest decrease in body weight, which they mentioned comes from both fat mass and fat-free mass. However, it is unclear if the reduction in fat-free mass was due to the loss of actual muscle or water. The authors do mention this and state that the loss of fat-free mass could come from non-muscle sources, since body cell mass was unaffected and grip strength improved. That could be the case, as a ketogenic diet would deplete glycogen stores, which would in turn reduce the body's water stores. Approximately 500 grams of glycogen is stored in the body's muscles, liver, and fat. When hydrated, about three to four grams of water bind to each gram of glycogen. Thus, when undergoing ketogenic diets, up to five kilograms of weight loss can come from just water alone.

The ketogenic diet also caused many changes that provide some insight into the importance of carbohydrates for proper metabolic function. The Vermont study established previously that T3 is extremely sensitive to reductions in carbohydrate intake, even when caloric intake is maintained. This likely explains the observed decrease in free T3, and subsequently total daily energy expenditure, without observed changes in thyroid stimulating hormone (TSH). Interestingly, various micronutrient cofactors required for free T3 function were also reduced according to the dietary logs: magnesium, iron, and selenium. Both magnesium and selenium are cofactors involved in the reaction that converts inactive T4 to active T3. Iron is involved in thyroid hormone synthesis via its ability to enhance the bonding between hemoglobin and thyroid peroxidase. These hormonal responses raise the question of whether long-term ketogenic dieting could negatively impair metabolic rate. Future work is needed to better understand if chronic ketogenic dieting continues to impair metabolic rate and thyroid hormone levels, and if those impairments eventually affect muscle mass, strength, and weight loss.

This study demonstrated that ketogenic dieting can promote decreases in body fat. While the authors observed a significant reduction in absolute VO_{2peak}, the subjects' relative VO_{2peak} remained stable. This suggests that the reduction in VO_{2peak} was triggered by diet-induced weight loss, not the diet itself. Overall, the data suggest that ketogenic diets may be beneficial to the general population aiming to reduce body fat while maintaining their current caloric intake and physical activity levels.

The big picture

According to the investigators, their findings show that six weeks of *ad libitum* ketogenic dieting does not impact physical performance in a clinically relevant way, although the diet may not be ideal for competitive athletes who covet absolute endurance capacity and power. Studies using trained endurance athletes and off-road cyclists had previously shown that ketogenic dieting does not affect maximal exercise performance on a graded cycling test. Whereas the off-road cyclist study demonstrated that ketogenic diets do not impair relative VO_{2peak} and do reduce fat and body mass like the reviewed study, the work done using endurance trained individuals with a similar pre-post design showed that 4 weeks of a ketogenic diet does not significantly affect absolute VO_{2peak}. Considering that this measurement was absolute and the test was done using a graded maximal cycling test, this is in direct contrast to the current study.

Studies using taekwondo high school athletes and elite gymnasts also found that a ketogenic diet did not affect maximal physical performance when tested using a maximal 2,000 meter sprint and strength measures, while a trial in elite race walkers showed decreased performance in a very-low carb diet compared to a high-carb diet (albeit only over the course of three weeks). While these measures of physical performance differ from the reviewed study, they do highlight the importance of considering the endpoint measurements when interpreting the current study. Although absolute values of maximal exercise capacity were affected in the current study, this was not in a way which would affect daily activities and performance. That being considered, the reviewed study's findings that ketogenic dieting does not affect relative maximal exercise capacity is consistent with previous studies, as are their findings that ketogenic diets reduce fat mass, body weight, insulin, and thyroid levels.

While more and more studies have started to look at the relationship between aerobic performance and ketogenic diets, a gap exists in the current research involving ketogenic diets and their long-term effects on strength and power. Similar to the reviewed study, others have shown that 4 months of a very low calorie ketogenic diet does not affect muscle strength. Work published this year even showed that 10 weeks of a ketogenic diet, when combined with resistance training, results in similar increases in muscle mass and strength when compared to a typical western diet.

Since the study was done with the intention of determining if a ketogenic diet could be suitable for the general population, it is important to note the observed increases in LDL and total cholesterol. Further studies on athletic populations and the general population, potentially using more specific tests (such as measuring LDL-P rather than the more commonly used LDL-C used in this study) can help determine what impact ketogenic diets have on blood lipids. Previous research has tended to focus on obese populations.

With previous studies in athletes suggesting that ketogenic diets may not be detrimental to physical performance, and the current study's findings suggesting that this type of diet could be detrimental to the general population, more long-term, controlled, studies are need to examine the link between physical performance and ketogenic diets. Additionally, considering the repeated trend of ketogenic diets inducing weight loss, significant efforts need to be made to utilize primary strength and aerobic fitness endpoints that are normalized to body weight.

Frequently asked questions

What are the main drawbacks to reducing carbohydrate intake for the physically active individual?

From the reviewed study, dropping carbohydrate intake

by way of a ketogenic diet resulted in decreased levels of thyroid hormone, a possible slight decrease in immune function (reduced platelet number), and a decrease in the pro-muscle building hormones insulin and IGF-1. While it is possible that this might not be significantly detrimental to everyday low intensity exercise, these types of hormonal changes might affect people training for muscle hypertrophy.

A reduction in T3 levels is linked to preventing adult growth and promoting insulin resistance. Additionally, decreases in T3 can be detrimental to reducing body fat, as this decrease impairs resting metabolic rate.

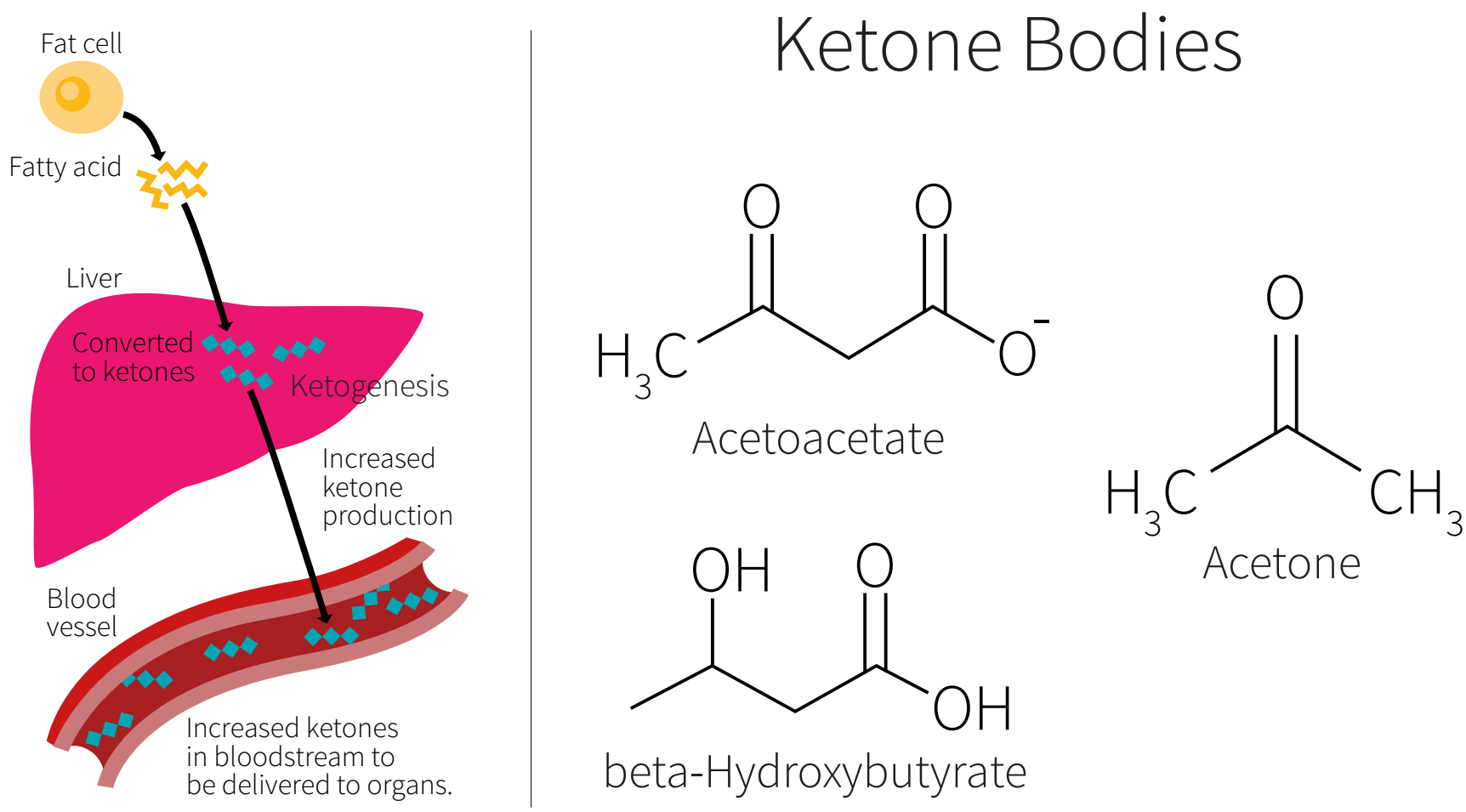
What are ketones and how do they provide fuel for the body in the absence of carbohydrates?

In conditions where liver glycogen stores are depleted (fasting, starvation, prolonged intense exercise, and low carbohydrate diets) the liver breaks down fatty acids and ketogenic amino acids into water-soluble fuel molecules known as ketones. Specific ketone structures are pictured in Figure 3. Ketones are then taken up by extrahepatic tissues and converted into a small molecule known as acetyl-CoA. Acetyl-CoA is oxidized in the mitochondria to make energy (ATP). Ketones are extremely energy rich, and through ketosis, ketones are able to take over for carbohydrates as the primary producer of energy in the body.

Why was protein intake limited to 15-20% during the intervention?

In classical ketogenic diets, protein intake is limited to a maximum of 20% of total daily energy intake. This is because protein can be converted to glucose through gluconeogenic pathways when carbohydrates are low. Thus, a diet low in carbs but too high in protein can halt ketone production and minimize the ability of the body to shift towards the oxidation of ketones for fuel. That being said, a diet without sufficient protein consumption can also be detrimental and lead to a decline in lean mass and physical performance.

Figure 3: Ketone production



What should I know?

A six-week, *ad-libitum*, ketogenic diet in healthy individuals reduces fat mass and body weight, and appears to have fairly minimal effects on relative physical performance measures. Implementation of this type of diet reduces levels of hormones involved in promoting muscle growth (insulin, IGF-1), impairs thyroid hormone levels, and decreases resting energy expenditure. Whether the long-term effects of these hormonal and metabolic changes are adverse is unclear. However, it appears that ketogenic diets are suitable for individuals looking to lose weight while maintaining their ability to carry out daily activities and aerobic exercise. ◆

There is still much to be learned about how ketogenic diets fare in different populations and for different outcomes. Discuss all things ketogenic at the ERD Facebook forum.