# Nutrient timing

Nutrient timing is a hot topic among fitness professionals and academicians alike. Depending on the audience, nutrient timing can elicit different thoughts as to what it truly means. Using the working definition as “the temporal positioning of nutrients throughout the day and/or relative to the exercise bout in order to maximise performance or improve body composition”, this chapter will examine different nutrients, guidelines and recommendations to best help clients reach their desired outcomes.

Fuelling strategies to enhance athletic performance and recovery are an important aspect of sports nutrition. Athletes often seek new methods to improve athletic performance and recoverability from demanding workouts or sport practices. As such, nutrition coaches should arm themselves with evidence-based information regarding fuelling strategies that maximise performance and recovery, no matter if the client is a professional athlete, a weekend warrior or someone striving to improve their health and well-being.

Macronutrients are substances required in large amounts by living organisms to survive and are the building blocks of the diet. The three macro-nutrients are carbohydrates, proteins and fats. Each macronutrient plays an important role in fuelling athletic performance and exercise.

Carbohydrates are the body’s fuel source and intake will determine the quality of energy (or, in this case, the work capacity) that is put out. Carbohydrates are broken down into glucose in the body and they help provide the energy that powers every move: from eating, breathing and thinking, to walking and running. Glucose is also the preferred energy source of our brain. Even though the brain accounts for just about 2% of total body weight, this tiny but powerful organ consumes about 20% of glucose-derived energy, making it the main consumer of glucose in the body.

Fibre is found in carbohydrates and plays a vital role in how quickly something is digested and used as energy. Fibre is made up of edible parts of a plant that are resistant to digestion and absorption in the small intestine. Meals further away from activity should be higher in fibre compared to the meals or snacks closer to the activity (1 to 2 hours before) so the food has time to digest and be available for energy.

While solid food is a great choice if time allows, for some clients or athletes, sipping a sports drink or chocolate milk on the way to the gym may be the most practical option, depending on the workout ahead. Other ideas include a piece of fruit with a bit of nut butter, yogurt or dried fruit with some nuts (about a 2:1 ratio of fruits to nuts), for example.

Protein comes from a variety of sources and does more for the body than just repair muscle. Protein is made up of amino acids and is required for many bodily functions including building and repairing tissues; providing the building blocks of bones, muscles, skin, cartilage and blood; and making enzymes and hormones. Protein is a necessary component of every cell in the body. Typically, athletes will need more than the required amount because their bodies are constantly at work building or repairing muscle.

According to the Institute of Medicine, the recommended amount of protein ranges from 10 to 35% of total energy. While that is a large range, there are more specific recommendations for more- and less-active individuals. The general RDA for protein is 0.8 gram/kilogram/day. This is the minimum intake to simply prevent deficiency. Most research and protein experts have found intakes should be higher, particularly for active individuals, where most research encourages 1.2 to 1.6 gram/kilogram/day or more, depending on the individual goal(s).

Fat provides a concentrated source of energy to an athlete (over double what carbohydrates and protein provide, with about 9 calories per gram versus about 4 calories per gram for carbohydrates and protein). In fact, fatty acids are the most abundant source of endogenous energy in the body, due to their high energy capacity as well as the copious amount of storage in even the leanest individuals. Fat also plays a vital role in nutrient absorption, hormone regulation, heart health, blood pressure regulation, protection of vital organs and hair and skin health.

Fat is essential for the absorption of fat-soluble vitamins A, D, E and K. While these are all important qualities of fat, it also helps provide the feeling of fullness (satiety). This may be important in terms of educating clients on sustainable energy; however, it may also impact the immediate availability of nutrients to working muscles, depending on the type and duration of physical activity.

Fat is stored within muscles as intramuscular triglycerides and can be accessed for energy while training. However, during long-duration exercise, the body uses these triglycerides that are stored within the muscles. In long-duration sports, it is important to replenish carbohydrates, protein and fat stores, as fat plays a bigger role in continuing to perform physical activity over long-duration activities. Ultimately, the athletes who most likely need this type of replenishment are those training for longer events such as Olympic distance triathlons or longer marathons. For these athletes, it is best to refer them to a qualified sports dietitian.

## Timing of nutrients

Nutrition is a fundamental priority for athletic populations, both recreational and professional, to provide sufficient energy for working muscles, help repair bodily tissues, regulate hormones and combat fatigue. The importance of the type of food a client consumes can determine the quality of their physical and mental performance. Carbohydrates provide the most immediate energy source, protein helps build and repair muscle, and fats help to regulate hormones in addition to producing energy for extended bouts of exercise.

An adequately fuelled body can store enough glycogen to fuel up to 120 minutes of continuous exercise. Remember the discussion of nutrient metabolism and energy systems from earlier in the chapter. This is where the understanding of those systems comes into play, to understand how ATP is produced. Food containing carbohydrates consumed during exercise can delay the depletion of muscle glycogen stores.

Estimated Energy Stores in Humans

| **Energy Source** | **Storage Site** | **Approximate Energy (kcal)** |
| --- | --- | --- |
| ATP-PC\* | Various tissues | 5 |
| Carbohydrate | Blood glucose | 80 |
| Liver glycogen | 400 |
| Muscle glycogen | 1500 |
| Fat | Serum free fatty acids | 7 |
| Serum triglycerides | 75 |
| Muscle triglycerides | 2500 |
| Adipose tissue | 80,000+ |
| Protein | Muscle protein | 30,000 |
| \*ATP-PC = adenosine triphosphate phosphocreatine | | |

### Nutrient timing applications: endurance vs. strength-based activity

Carbohydrates and fat are the main substrates used by the body during an endurance activity. The intensity of the activity determines the contribution of each. Carbohydrates are the main substrate used during moderate- to high-intensity exercise, whereas fat is the predominate substrate used during lower-intensity exercise. In addition to intensity, as the exercise duration continues (prolonged bouts of exercise), fuel substrates begin to shift, moving more from carbohydrates (glycogen) to fat stores as well.

Like endurance activity, resistance-based exercise relies primarily on carbohydrates as the primary fuel source, making liver and muscle glycogen stores important for performance. It is important to keep muscles fuelled and hydrated to optimise performance and support adequate recovery. The body takes time to digest foods, so total energy intake and composition should be considered in the meals leading up to exercise. During exercise (>60 mins), glycogen depletion can be delayed when exogenous glucose is present.

**Endurance exercise**

The amount of carbohydrates an endurance athlete needs varies tremendously based on their size, gender, training programme and sport. Often, elite endurance athletes struggle to consume enough calories to balance the day-to-day energy demands. Glycogen stores are maximised with a higher carbohydrate diet and can be depleted with high-volume exercise, such as consistent endurance activity. Carbohydrates are critical for an endurance athlete and a continuous supply (8 to 12 grams/kilograms/day) is optimal. Athletes who continuously eat a carbohydrate-rich versus a higher protein- or fat-rich diet have greater muscle glycogen stores to draw from during training and racing.

It is well-established that adequate muscle glycogen stores help delay the onset of fatigue (Impey, 2018). While research around carbohydrate timing and intake is plentiful, at this time, research is inadequate to also suggest the timing of the fat intake as it relates to exercise.

Endurance athletes should consume frequent meals and snacks throughout the day and avoid skipping meals. Good-quality carbohydrates, lean protein and healthy fats should be the focus of all meals and snacks. Active individuals training for a race of some kind (e.g. 5k or 10k) and exercising consistently for over an hour should also ensure adequate carbohydrate intake to fuel exercise and speed up recovery from training bouts.

Fueling Strategies - Endurance Athletes

|  |  |  |
| --- | --- | --- |
| **Pre-Exercise Meal** | | |
| Timing | Composition | Hydration |
| 3 to 4 hours before exercise | High in quality carbohydrates (e.g., English muffin, pancakes, waffles, lower fiber cereal, or whole grain bread)  Lean protein (e.g., eggs, turkey, ham, roast beef, chicken, or tuna)  Low in fibre and fat | 4 hours before activity, start hydration strategies.   * Example: Drink about 20 oz water. |
| **Pre-Exercise Snack** | | |
| Timing | Composition | Hydration |
| 30 minutes to 1 hour before exercise | High in carbohydrates (e.g., chocolate milk, yogurt, fruit and nut butter, or sports drink with protein powder)  Moderate in protein  Low in fat and fibre | ​​​​​​​Continue hydrating.   * Example: Drink 5 to 10 oz of water. |
| **Peri-Exercise Meal** | | |
| Timing | Composition | Hydration |
| Carbohydrate intake should begin shortly after onset of activity, but only if the exercise session is continuous and will last more than 60 minutes. | Products providing multiple transportable carbohydrates such as sports gels, blocks, sport beans, sports drinks, fruit, or high-carbohydrate bars with little to moderate protein | Continue hydrating, which is dependent on the athlete’s sweat rate.   * Example: 0.4 to 0.8 litres per hour   Sports drinks should contain 6 to 8% carbohydrate solution.  Replace electrolytes lost with sports drinks or foods high in sodium and potassium. |
| **Post-Exercise Meal/Snack** | | |
| Timing | Composition | Hydration |
| Critical only if another exercise bout is planned within 24 hours; however, no harm in replenishment soon after exercise  2 hours after exercise (Continue meals in 2-hour intervals up to 6 hours.) | Quality carbohydrate and lean protein  Carbohydrates: 1 to 1.2 g/kg per hour for 4 to 6 hours post-exercise  Protein: 0.25 to 0.3 g/kg post-exercise | Continue hydrating.   * Example: Drink 16 to 24 oz water or sports drink for every pound lost during exercise (1.25 to 1.5 litre per kilogram of body weight lost during exercise). |

**Resistance exercise**

For a strength-training athlete, the main goals are to provide calories for daily activity and intense training and competition, and to build and repair muscle mass. Focussing on eating and hydrating often and nutrition before, after and possibly during exercise are the keys to training and performing at an optimal level and achieving specific fitness goals. While traditional resistance exercise has less of an impact on muscle glycogen concentration than exhaustive endurance exercise, studies have demonstrated that resistance exercise can significantly decrease muscle glycogen as well.

It is also well-established that resistance exercise stimulates muscle protein synthesis (MPS), which is further stimulated and augmented by protein ingestion. MPS is an important factor for increasing the size of muscles, known as muscle hypertrophy.

Nutrient timing is simply one part of the equation of increasing muscle mass. In fact, muscle hypertrophy cannot occur without a properly designed and simultaneous resistance-training programme. In reality, there are many factors that play a role in achieving hypertrophy and strength gains, including hormone levels, stimulating lean muscle with a properly designed resistance-training programme, and the consumption of the right fuel (total energy and protein).

Fueling Strategies - Strength Athletes

|  |  |  |
| --- | --- | --- |
| **Pre-Exercise Meal** | | |
| Timing | Composition | Hydration |
| 2 to 4 hours before exercise | High in quality carbohydrates (1 to 4 g/kg)  20 to 30 g lean protein  Lower in fibre and fat | 4 hours before activity, start hydration strategies.   * Example: Drink about 20 oz of water. |
| **Pre-Exercise Snack** | | |
| Timing | Composition | Hydration |
| 30 minutes to 2 hours before exercise | High in carbohydrates  Moderate in protein  Low in fat and fibre | Continue hydrating.   * Example: Drink 5 to 10 oz of water. |
| **Peri-Exercise** | | |
| Timing | Composition | Hydration |
| Carbohydrate intake (and possibly protein) should begin shortly after onset of activity only if exercise session lasts more than 60 minutes. | 30 to 60 g carbohydrates per hour spaced every 15 to 20 minutes for exercise lasting over an hour | Continue hydrating, which is dependent on the athlete’s sweat rate.   * Example: 0.4 to 0.8 litres per hour   Sports drinks should contain a 6 to 8% carbohydrate solution.  Replace electrolytes lost with sports drinks or foods high in sodium and potassium. |
| **Post-Exercise Meal/Snack** | | |
| Timing | Composition | Hydration |
| Critical only if exercising again within 24 hours, but not harmful to try to consume quality carbohydrates and protein soon after exercise session comes to an end and at repeated intervals (about every 4 hours), particularly when it comes to protein | Quality carbohydrates and lean protein  Carbohydrates: 1 to 1.2 g/kg for 4 to 6 hours post-exercise  Protein: 20 to 30 g (0.25 to 0.3 g/kg) consumed after exercise | Continue hydrating.   * Example: Drink 16 to 24 oz of water or sports drink for every pound lost during exercise (1.25 to 1.5 liter per kilogram of body weight lost during exercise). |

## Myths and hot topics

Nutrition brings a bevy of information, myths or otherwise. There are a variety of topics that can be explored in this section, but a few of the most common are highlighted.

**Is it possible to build muscle and lose fat simultaneously?**

For years, most experts and the associated scientific weight-loss literature advised that weight loss inevitably would lead to both fat and muscle loss, with most of the loss coming from lean tissue. On the surface, this makes sense: increasing lean body mass requires a positive energy balance, whereas a negative energy balance is needed to decrease body weight. The idea is that when a person is in an energy deficit, it makes it nearly impossible to simultaneously increase lean body mass.

However, more recently, some data has been published challenging that long-held belief. In fact, losing body fat and gaining muscle simultaneously is possible with the right diet and training program. A commonality among the studies that support this notion is the quantity (and quality) of protein in the diet. Several studies have now demonstrated that this seemingly impossible feat is truly possible (Longland et al., 2016, Pasiakos et al., 2013).

One study specifically examined three different protein intake levels during a calorie-controlled weight-loss study:

* The U.S. RDA (0.8 grams protein/kilogram body weight)
* Twice the U.S. RDA (1.6 grams protein/kilogram body weight)
* Three times the U.S. RDA (2.4 grams protein/kilogram body weight).

Researchers provided all meals and supervised all exercise routines among the subjects during the study. Those subjects who ate double the RDA of protein (1.6 grams protein/kilogram body weight) and exercised were able to lose fat while preserving lean tissue. Interestingly, subjects who ate 2.4 grams protein/kilogram body weight did not experience more weight loss than the group who ate 1.6 grams protein/kilogram body weight. Regardless, both higher protein groups lost more weight than the group eating at the RDA level of 0.8 grams protein/kilogram body weight.

The results of this study support others with similar findings: increasing protein intake while in a negative energy balance can help preserve muscle.

Critical!

Nutrition alone cannot build muscle. While protein is necessary for the repair and building of muscle, without a proper resistance-training program to stimulate growth, mindlessly adding protein itself is not an effective strategy for increasing lean mass.

When an athlete sets a goal to lose weight or gain muscle, encourage them to focus on this goal during their off-season. During the season, training should focus on skill sets and performance. The fuelling techniques for performance are focused on fuelling the activity for optimal performance and then replenishing muscle glycogen stores and facilitating muscle repair from protein consumption.

Encourage athletes trying to lose or gain weight to focus on eating a variety of foods. High-quality protein, whole grain carbohydrates, and healthy fats are essential for a weight increase or reduction plan. Table: Time Needed to Digest Macronutrients shows the general time it takes for macronutrients to digest in the body. This is important when creating a plan.

Time Needed to Digest Macronutrients

|  |  |
| --- | --- |
| Macronutrients | Time It Takes to Digest/Leave the Gut |
| Carbohydrates | Up to 1 to 2 Hours |
| Protein | Up to 3 to 4 Hours |
| Fat | Up to 6 Hours |

Food for Thought

Building muscle requires increased strength training and calories to aid in the replenishment and repair of muscles. Weight loss in overweight and obese persons through diet and/or exercise can offer many benefits; however, energy restriction alone typically leads primarily to weight loss from mostly lean tissue. There are some ways to preserve lean mass during caloric deficits. For example, one study found that consumption of dairy foods and dairy-derived calcium lead to greater weight loss and fat mass loss (Josse et al., 2009). In young, recreationally active men and women, this study observed an advantage of consuming low-fat milk with resistance exercise in promoting lean mass gains both acutely and over time in conjunction with fat-mass loss, despite participants being in a positive energy balance. This research shows the benefit of the types of food consumed and should be considered as a strategy for weight loss and lean-mass retention

**Carbohydrate periodization**

Carbohydrate periodization involves manipulating carbohydrate intake on a day-to-day or even a meal-to-meal basis. Low- to moderate- to high-carbohydrate meals are used to alter the availability of glucose in a proceeding training session.

Before discussing if this strategy works, it is important to quickly review the energy systems. Remember from earlier, ATP synthesis from fat metabolism is too slow to supply working muscles with the energy they need during intense exercise. Carbohydrates are the predominant fuel source for endurance activity. There is an increase in the use of carbohydrates as the intensity of exercise increased. It was also demonstrated that as exercise increased in duration, the use of carbohydrates decreased and an increase in free fatty acids was shown. The conditions of this study are important to note because the subjects were in an overnight-fasted state with no carbohydrates fed before or during exercise, which we know would favor the use of free fatty acids over muscle glycogen stores.

Food for Thought

Some clients may come to exercise in the morning on an empty stomach. They may do this for a few reasons: clients may not have enough time in the morning for a pre-workout meal, they may not be hungry, or they believe exercising on an empty stomach burns more fat. While exercising first thing in the morning on an empty stomach may, in fact, shift the body’s fuel source to primarily free fatty acids, this does not translate to fat loss or to enhanced performance. Encouraging clients to have something on the way to the gym, even if it is small like chocolate milk or a piece of fruit, may be of benefit and help them feel better during the workout and allow them to exercise at a higher intensity.

After this was discovered, other studies, including one seminal one by Goedecke investigated the use of training with low-glycogen ingestion, or a high-fat diet, in an effort to increase free fatty-acid oxidation and spare muscle glycogen to delay the onset of fatigue. In this study, the metabolic adaptations were measured in sixteen endurance-trained athletes after 15 days of a high-fat diet (69% of energy from fat) compared to a control group (30% of calories from fat). It is important to note that in this study all subjects were eating an isocaloric diet.

The researchers discovered in as little as 5 to 10 days that there was a shift from carbohydrates to fat oxidation during exercise. Remember, total glycogen in the body is limited compared to fat storage. Although this method showed an improvement in the body’s ability to oxidize free fatty acids throughout exercise, it also showed a decrease in the body’s ability to oxidize carbohydrates. This is important because without the ability to oxidize carbohydrates, the body’s ability to efficiently provide ATP decreases and performance could suffer.

This is how the concept of periodically restricting carbohydrates around training was created. More recent studies have shown that periodically completing endurance training sessions (e.g. 30–50% of training sessions) with reduced carbohydrate (CHO) availability modulates the activation of acute cell signalling pathways (73% of 11 studies), promotes training-induced oxidative adaptations of skeletal muscle (78% of 9 studies), and, in some instances, improves exercise performance (although only 37% of 11 studies demonstrated performance improvements).

Now, with the scientific basis for carbohydrate periodization discussed, how might this be applied to clients?

Carbohydrate Periodization

| **Scenario** | **Description** |
| --- | --- |
| Fasted Training | Waking up in the morning and exercising in a fasted state – The studies on this method are still inconclusive. |
| Recover Low | This method is where a client restricts carbohydrates in the post-exercise period with the intention of enhancing pathways for fatty-acid oxidation. |
| Sleep Low, Train Low | In this method, athletes perform an evening training session, restrict carbohydrates during overnight recovery, and then complete a fasted training session the following morning. The total time with reduced muscle glycogen is between 12 to 14 hours. Using this technique for 1 to 3 weeks showed improved endurance efficiency. |
| Twice-A-Day Training | Athletes complete a morning session to deplete muscle glycogen and follow the day up with a reduced carbohydrate intake, so the second exercise session is with reduced muscle glycogen. |

**Anabolic window**

The anabolic window refers to a period of time following exercise in which nutrients such as protein and carbohydrates can be used to maximize muscle growth and glycogen replenishment. There has been much discussion surrounding this post-workout window of time and several lines of research have begun to answer a few fundamental questions:

* How long does the post-workout window last for maximizing muscle growth?
* How long does the post-workout window last for maximizing glycogen replenishment?
* How much carbohydrate and protein should be consumed during this period?

According to a study done on nutrient timing, theoretically, consuming the proper ratio of nutrients during this time not only initiates the rebuilding of damaged muscle tissue and restoration of energy reserves, but it does so in a super-compensated fashion that enhances both body composition and exercise performance. This window of time was thought to be within 30 to 45 minutes after exercise, but up to 1 to 2 hours after is when protein synthesis happens most effectively. Recent data, however, questions that anabolic window and suggests that the total amount of protein and carbohydrates eaten over the course of the day is more important for body composition and performance than nutrient-timing strategies specific to the workout itself.

In this review, the authors examine the literature around this often-touted anabolic window to better provide practical strategies for the typical client. The initial thought, based on data from Ivy and colleagues, was that the suggestion to refuel immediately post-exercise was to replenish glycogen as rapidly as possible. While research has, in fact, supported the theory that glycogen repletion is maximized when carbohydrates are fed soon after a workout, the practical significance of doing so is limited to those exercising multiple times daily, usually in endurance-based sport. The application of this data, however, does not appear to carry over for the clientele most fitness professionals will encounter (e.g., the stay-at-home dad or busy executive simply looking to improve health or maybe lose a bit of weight).

Coach’s Corner

While research around the anabolic window has limitations and is often inconsistent, the general principle around replenishing with carbohydrates and protein remains consistent. The question of how long the anabolic window actually is still remains unclear; however, the reviewed studies show it might be longer than 30 to 45 minutes post-exercise. Apply reasonable strategies with your clients and stress a consistent healthy diet from the beginning of the day to the end.

Outside of carbohydrates and glycogen, for many years it has been encouraged to also consume protein soon after a workout has ended, to slow or prevent muscle protein breakdown. While some data does support this notion (Levenhagen et al.., 2001), other studies do not. There is no clear indication of the true long-term benefits. Practically speaking, however, there are certainly no detriments either. That said, while it does not seem to be imperative to encourage clients to consume something immediately post-workout, there is certainly no harm in encouraging clients to seek out quality carbohydrates and protein around a workout.

**Breakfast: the most important meal of the day?**

*Breakfast—*the word itself means to *break* the *fast*. Breakfast is often called the “most important meal of the day,” but, in reality, all meals play important roles. Breakfast is unique in that the body is coming from a fasted state and glycogen stores are not quite optimal. It is also a bit of a dehydrated state, negatively affecting physical and mental performance. Therefore, because the body is in a fasted and dehydrated state, it is extremely important to start the day off right each morning with a quality, nutritious meal, especially when it comes to physical performance.

Research tells us breakfast consumption shows improvement in behavior, cognition, concentration, and school performance for the children. In adults, breakfast can lead to improved quality of overall diet, micronutrient intake, body weight, and other lifestyle factors. The human brain uses up to 70% of the glucose taken in to survive (and thrive). If the body is not fed in the morning, less-optimal levels of glucose are expected, and, in turn, physical and mental performance can suffer.

Just because breakfast was eaten, does not mean it is okay to skip the next meal. Consistently eating quality foods every few hours will help the body get all necessary nutrients and function properly and optimally, especially in relation to athletic performance.

Nutrient Timing Summary

|  | **Little Effect** | **May Have an Effect** | **Maximal Effect** |
| --- | --- | --- | --- |
| Carbohydrate | Moderate intensity resistance training (< 60 minutes) in a fed state | Exercise in a fasted state  Exercise > 60 minutes | Continuous exercise > 60 minutes  Repeat bouts of exercise (training or competition) within 24 hours |
| Protein | Timing around endurance exercise in a fed state | Timing around resistance exercise in a fed state | Timing around exercise in a fasted state or if previous meal was > 3 hours prior |

Nutrient timing is important but maybe not as important as once thought. As the level of competition, skill level and workouts increase, so may the importance of nutrient timing. In a generally active individual trying to lose, maintain or gain weight, a consistent healthy diet with sufficient carbohydrates, protein and fat is more important than the timing of the workout and meal. The timing of meals becomes more important when an individual's goal includes extreme muscle or strength gains, extreme fat loss in advanced exercisers, and continuous and exhaustive training lasting over 60 minutes or more. Competitors with multiple competitions with minimal time between require more intense timing of nutrition.

Other studies showed that protein, carbohydrates and creatine taken around an activity session might lead to more muscle mass and increased strength than those same nutrients eaten further away from the session. However, further research using the same protocol as this study failed to find a similar result. There is also a placebo factor in nutrient timing for some levels of exercise less than 60 minutes in duration. Research has led to findings around the effects of the brain sensing the presence of carbohydrates and potentially other nutritional components in the oral cavity, which can enhance perceptions of well-being and increase self-chosen work rates.

The job of a research study is to help answer a very-specific question around very-specific situations while controlling as many variables as possible. More often, however, research findings open the door to asking more questions, as is the case with this very topic. All of these findings open opportunities to expand the research question. For Nutrition Coaches, using the most-current and best-available information to better help each client with their unique goals and requirements is the main goal, ultimately leading to the most success.

In this chapter, you learned about:

* The basics of metabolism.
* Nutrient-timing strategies for performance (endurance or strength).
* Nutrient-timing strategies for altering body composition.
* Key myths and hot topics related to nutrient timing.

The role nutrient timing plays within an overall nutrition strategy.