

Nutrition

The 4th Discipline of Triathlon

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Nutrition Planning For Endurance Sports Objectives

- What is Sports Nutrition?
 - Carbohydrates, Protein, Fats, explained
- Digestion of the Endurance Athlete
- Key Takeaways about nutrition planning before, during and after Endurance Exercise
- Hydration
- Case Study



What Is Sports Nutrition



Sports nutrition is about helping your body maintain balance and generating the necessary energy for athletic activities. This is done by converting energy from food and fluid that are consumed and absorbed into the body.



The nutrition choices each athlete makes can have a significant impact on performance. Selecting the correct nutrients at the correct times will take planning and practice.



An athlete must learn to balance the three types of macronutrients; Protein, Fat, and Carbohydrates, along with micronutrients and hydration to achieve the optimal performance outcomes.



Macronutrients: Understanding How Digestion Works

- Carbohydrates: typically, are the first to get broken down (when compared to protein and fats) have smaller cell structures and easy to make energy. Gets insulin on board for more rapid absorption
- Protein: Digested second, larger molecules, keeps you fuller longer. Amino acids help with a variety of functions, can help the absorption of carbohydrates, muscle recovery, wound healing ect..
- Fats: Digested last and slowly, Can take up to 6-8 hours to completely empty from the stomach, makes you feeling fullest longer. Needed for brain function, storage of fat soluble vitamins...

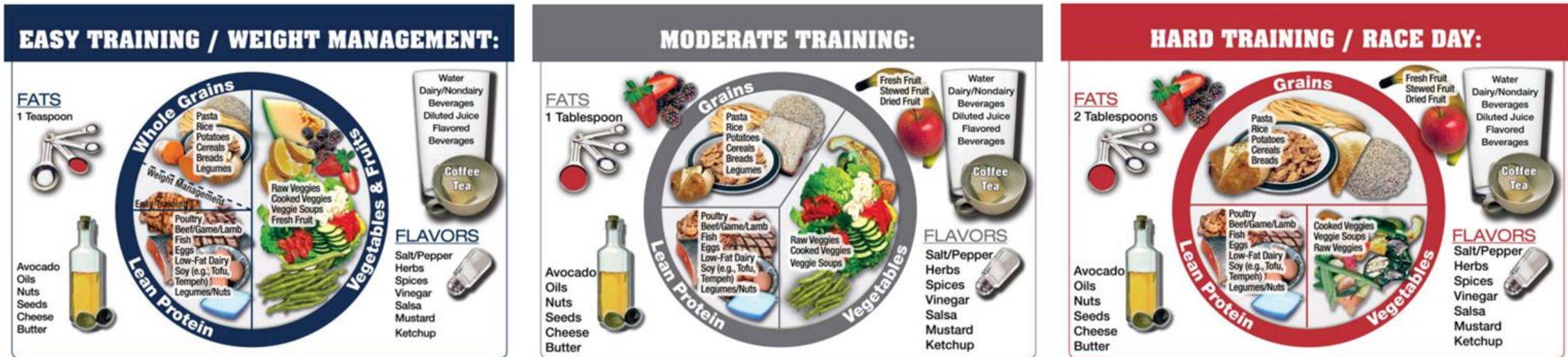


USOPC Sports Athletes Plate

EASY An easy day may contain just an easy workout or tapering without the need to load up for competition with energy and nutrients. Easy day meals may also apply to athletes trying to lose weight and athletes in sports requiring less energy (calories) due to the nature of their sport.

MODERATE A moderate day may be one where you train twice but focus on technical skill in one workout and on endurance in the other. The moderate day should be your baseline from where you adjust your plate down (easy) or up (hard/race).

HARD A hard day contains at least 2 workouts that are relatively hard or competition. If your competition requires extra fuel from carbohydrates, use this plate to load up in the days before, throughout, and after the event day.



<https://www.usopc.org/nutrition>

Protein

Dietary protein is found in both animal and plant-based foods and is required for muscle tissue recovery and growth. It aids in satiation and fullness when eating and is necessary for a properly functioning and strong immune system.



The timing and distribution of intake matters

- Aim for 4 times a day spaced by 3 hours

Ingestion before sleep results in increased muscle mass and strength



Plant proteins vs Animal proteins?

Dietary fat is a key part of an athlete's diet.

- In addition to enhancing the taste of many foods, essential fatty acids are required for biological processes like maintaining cell membranes.
- They have been shown to have anti-inflammatory effects
- Are required to absorb and transport fat-soluble vitamins like vitamins A, D, E, and K.



Carbohydrates



Carbohydrates are the most important source of energy for an endurance athlete as they are used at twice the rate as fat for energy. They are the primary source of energy in both aerobic and anaerobic exercise even though they are stored in the body in a very limited quantity.



Carbohydrates come in various forms and types and are found in sports drinks, recovery beverages, gels, shots, blocks, and other products.



Carbohydrates To Energy

- Carbohydrate digestion begins in the mouth and continues through the stomach and the intestines
- Glucose uses a sodium dependent transporter (SGLT1) for absorption
 - The glucose transporter has maximum limit of 60g of carbohydrates per hour
- Fructose uses a different transporter (GLUT5) for absorption and can significantly increase hourly energy intake, so total grams of carbohydrates can increase up to 90-120gm/hr in some elite athletes.
- The most rapid absorbing mixtures of carbohydrates will be a balanced combination of fructose and glucose containing Maltodextrin, Fructose, Sucrose, and Dextrose



Carbohydrates Continued

- Carbohydrate Storage: as glycogen in the liver can only store ~100gm, it is important to practice increasing exogenous carbohydrate availability.
 - The ability to store muscle glycogen improves with training status
 - During sleep liver glycogen stores decrease so, in the morning you can be substantially depleted
 - BUT muscle glycogen stores are typically not affected by an overnight fasting period
 - So training your muscle to store more glucose can improve performance, and tolerance to sports nutrition products
 - Carbohydrate Loading...



What about Carbohydrate Loading?

- Very High Carbohydrate Diet (8-12gm per kg of current body mass) 48-36 hours before competition.
 - Case Study: 75g (165#) would need total ~750gm CHO for 2-3 days before their event
 - Easier way to look at this, is 70% of your calories for 2-3 days before your race should come from Carbohydrates
- Glycogen holds onto water, when properly fueled can help properly hydrate as well.
 - Might notice some weight shifts due to extra water weight
- When not to use Carb Loading? Any event that will take you less than 90 min to complete, did not show benefits when carb loaded
- A mix of monosaccharides have been more effective on replenishing glycogen stores



The Athlete's Gut

Gastric Emptying

- The rate at which substrates leave the stomach
- Carbohydrates (simple sugars) leave the stomach first
- Protein and fats can take up to 6 hours to leave the stomach

Osmolarity

- The concentration or “solutes” in liquids
- Hypo/hyper and Isotonic and why it matters

Gut Permeability

- Less blood flow to the gut means less permeability
- What is Permeability?
- What does this mean for in-season training



Gastric Emptying

- Is adaptable and can be trained, when you increase the carb receptors (with practice) less incidence of GI distress
- The stomach is elastic, learning to take more means more room in the stomach and less “sloshing”
- Elevated core temperature can decrease blood flow to the gut making it harder to take in the right volume the hotter you get
- Endurance exercise shuttles blood to the muscles AWAY from the gut making nausea, cramping and abdominal pain more likely

Jeukendrup AE. Training the Gut for Athletes. Sports Med. 2017 Mar;47(Suppl 1):101-110. doi: 10.1007/s40279-017-0690-6. PMID: 28332114; PMCID: PMC5371619.

Osmolarity

- The concentration of a certain solution
- Hypertonic solutions: concentration too high, causing water to flood the bowel → osmotic diarrhea :(
 - Example Juice, soda
- Hypotonic solutions: concentration is too low, diluting the blood and contributing to low blood pressure, low sodium, low potassium
 - water, super diluted electrolyte beverages
- Isotonic Solutions: the right balance between solutes (carbs, electrolytes, other micronutrients)
 - Liquid IV, Drip Drop, Gatorade Endurance

Rowlands DS, Kopetschny BH, Badenhorst CE. The Hydrating Effects of Hypertonic, Isotonic and Hypotonic Sports Drinks and Waters on Central Hydration During Continuous Exercise: A Systematic Meta-Analysis and Perspective. Sports Med. 2022 Feb;52(2):349-375. doi: 10.1007/s40279-021-01558-y. Epub 2021 Oct 30. PMID: 34716905; PMCID: PMC8803723.

Gut Permeability

Sympathetic Nervous System AND GI circulatory pathways provides blood flow to working muscles, and away from the gut

Less blood to the gut more permeable it can become

A normal gut is “selectively” permeable and want to let the good stuff in (vitamins, minerals, nutrients) and keep the bad stuff out (too much bacteria, viral infections)

When core temperature rises which leads to increased hypoxia in cells, the hotter/longer you go the more “leaky” the gut can become

Karhu, E., Forsgård, R.A., Alanko, L. *et al.* Exercise and gastrointestinal symptoms: running-induced changes in intestinal permeability and markers of gastrointestinal function in asymptomatic and symptomatic runners. *Eur J Appl Physiol* **117**, 2519–2526 (2017). <https://doi.org/10.1007/s00421-017-3739-1>

Troubleshooting GI Distress

Full/Sloshy? Have you trained with enough volume? Is the fluid too concentrated and not leaving the stomach rapid enough?

Abdominal Cramping or abdominal pain? solutes or concentration, hot environments, duration into an event

Muscle cramping: imbalance of electrolytes or too much water, not enough lytes or water?

Bonking/Hitting a wall? Not enough nutrition or calories and carbs

Loose Stools? Not enough substance to your nutrition plan (fiber, protein fat), too much at once are you trying to “make up” your nutrition plan?



Key Impacts

-  Increased HR & Body Temperature
-  Higher Perceived Exertion
-  Delayed Gastric Emptying
-  Decreased Mental Concentration
-  Decreased Sweat Rate



Keys to Hydration

- Know your sweat rate: How much do you need to consume based on how much you sweat during exercise?
- Heavy Sweater? You are mostly likely going to meet your fluid losses during exercise, at most you can only absorb 4 cups (32 ounces) on the bike and 2-3 cups (16-24 ounces) on the run
- Balance of water and Electrolyte beverages, there can be too much of a good thing



Nutrition Targets

The pre-event fueling window opens about 4 hours before the activity and slowly closes about 30 minutes before the start. Every athlete is unique and nutrition plans **must be practiced and adjusted**.

Timing	Fluid	Carb	Sodium
Before	4 hour before: 18 oz (5-7ml/kg) 2 hours before: 13 oz (3-5ml/kg) Up to race: ad lib	4 hour before: 240g (3-4g/kg) 2 hours before: 30-75g Up to race: ad lib	450-1120 mg per Liter (or 32 fl. oz.) (sports drink, small amounts of salty food)
During	Based On Sweat Rate Testing	70g -100g per hour	Based On Sweat Rate Testing
After	16-24 fl oz per lb lost	84g or ~340 calories	Consume foods and fluids that contain sodium to facilitate rehydration



Case Study: Pre-Race/Long Workout Day Meal

(or morning of)

Female Ironman Athlete, 65kg (145#)

Race Start 7:00am

Wake up: 3:00am

- Breakfast/First Meal between 3:30-4:00pm
 - ❑ GOAL CARBS: 1-4 gm/kg >> 65gm-260gm
- FLUIDS: 8-16 ounces with breakfast and continue to drink until start line
- Protein? Some maybe 15-25gm at this meal, low priority
- Fat: Keep this low NO MORE than 10gm at this time



Case Study: Pre-Race Meal

Female Ironman Athlete, 65kg (145#)

What does that look like?

Reminder: Nutrition Targets: 150-200gm Carbs (2-3gm/kg), a little protein and even littler fat

Example

- ✓ 2 cup Honey Nut Cheerios = 60gm CHO
- ✓ 1 cup of skim lactose free milk = 12gm CHO + 7gm PRO
- ✓ 8 ounces Gatorade Endurance = 15gm CHO
- ✓ 1 whole banana sliced on toast with 1 tablespoon honey = 60gm CHO
- ✓ Total: 147gm CHO, ~600 calories



Pre-Race Nutrition Extras

Female Ironman Athlete, 65kg (145#)

1-2 Hours
Before Race

Gel and Lytes
(16-24 Ounces)

30 Min
Before Race

Gel and Water
(8 Ounces)

Continuously

Hydrate Until
Urine Is Pale



Case Study: Race Nutrition Plan

Female Ironman Athlete, 65kg (145#)

What To Consider

- Goal 75gm CHO per hour
- 32 ounces of fluids on the bike (based on sweat rate)
- 16 ounces of fluids on the run
- Sodium: ~every 1000mls of sweat (about 4 cups) = 1000mg sodium, 1000mg NA every 1 hour based on sweat rate
- Potassium only about 150-200mg/L of sweat, typically do not need potassium supplementation (can cause heart arrhythmias)



Case Study: Race Nutrition Plan

Female Ironman Athlete, 65kg (145#)

- In Race Nutrition Goals
 - 75gm Carbohydrates per hour
 - 32 ounces of fluid per hour
 - 1000mg of sodium per hour
- Nutrition Plan per 60 min
 - 1 Maurten gels (25 CHO)
 - 1 Honey Stinger waffle (21 CHO)
 - 16 ounces Gatorade Endurance (30 CHO)
 - 16 Ounces water
 - 2 Salt Stick caps
- ✓ 76gm CHO, 32 Ounces fluid, 920mg Sodium



Case Study: Recovery

Female Ironman Athlete, 65kg (145#)

Hydration: 2-3 cups for every pound loss or until your urine is pale

Carbohydrates: 1.2gm/kg within in the first 1-2 hours

Protein: 20-30gm to start

After long days full recovery nutrition can occur after a few meals, after a full distance Ironman race may take up to a few days to fully recover your nutrition stores



Other Things to Consider

- Vitamins and minerals
- Bowel movements (too loose or constipated?)
- Probiotics
- Supplements (protein, caffeine, creatine, BCAAs)
- Immunity after long workouts/races



Questions?

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