



# Dietary Carbohydrate

for Female Athletes

## Introduction

All of the foods and fluids that athletes eat provide nutrients which have specific roles in the body. Carbohydrates are a macronutrient (along with protein and fat), which are required in larger quantities in comparison to micronutrients (vitamins and minerals). The information below will provide guidelines on daily carbohydrate recommendations to support both the health and performance of female athletes. In addition, it will cover some of the barriers that female athletes may face in order to meet carbohydrate recommendations.

## Dietary carbohydrate

There are three main types of dietary carbohydrate which are:

### Sugar

also known as monosaccharides or disaccharides because they are made up of single or double sugar molecule(s). They can be naturally occurring sugars (e.g., in fruit or milk), or added sugars which are those added during processing (e.g., fruit canned in syrup or sugar added to make a cookie). On food labels, sugar is often referred to by its chemical name (e.g., glucose, sucrose, fructose, lactose, maltose). Sugars are an energy source for the body.



### Starch

also known as polysaccharides because they are more complex carbohydrates made up of multiple sugar molecules joined together by glycosidic bonds. When starches are consumed, they are broken down by the body into units of glucose, which provides energy to the body.



### Fiber

a complex group of sugars (polysaccharides) from plant foods which cannot be digested in the small intestine. Instead, they are completely or partially broken down (i.e., fermented) by bacteria in the large intestine.



### Monosaccharide

Single sugar

### Disaccharide

Two sugar molecules linked

### Polysaccharide

Many sugar molecules linked

## Carbohydrate use and storage

Ingested dietary carbohydrates provide energy to the muscles, brain, and nervous system. Following ingestion, carbohydrates are broken down into smaller sugar molecules, which are converted into glucose by the liver to be used for energy. If glucose in the bloodstream exceeds energy needs, glucose will be converted into glycogen and stored in the body. The body can store ~500 grams of carbohydrate as glycogen in the liver and muscle, which can be broken down and used when energy is needed.

The liver can store up to ~100 grams of glycogen at any given time. This glycogen is primarily used to maintain blood sugar and energy levels throughout the day. In the muscles, a larger amount of glycogen can be stored (~400 grams). The glycogen in the muscles is a secondary storage facility, carbohydrates are stored there when the liver has reached capacity. For athletes, muscle glycogen, and the breakdown of glycogen to glucose in the liver, is used by the muscles during exercise to provide energy.

### Each gram of carbohydrate provides ~4 kcal of energy.

The contribution of carbohydrate to energy metabolism during exercise changes depending on exercise type (Figure 1). During high intensity endurance or sprint-type exercise, carbohydrates are the predominant energy source. During this type of exercise, the body will use glycogen stores, and sometimes they may even become depleted. When glycogen stores run low, the body may fatigue which can result in impaired physical and cognitive performance.

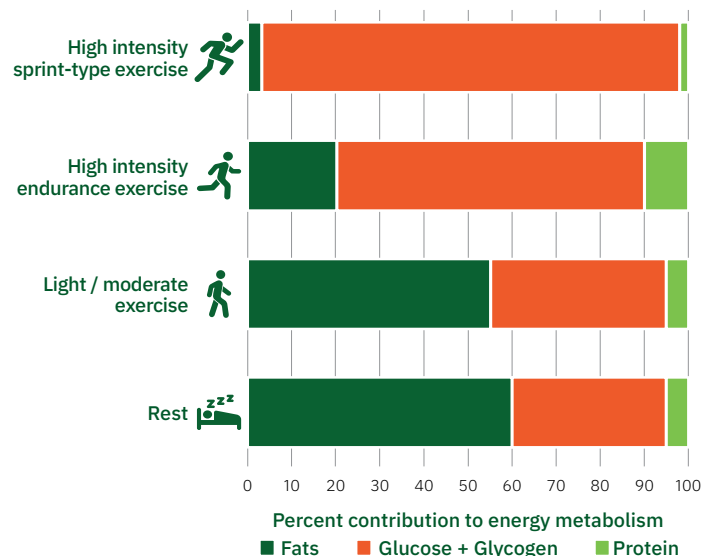
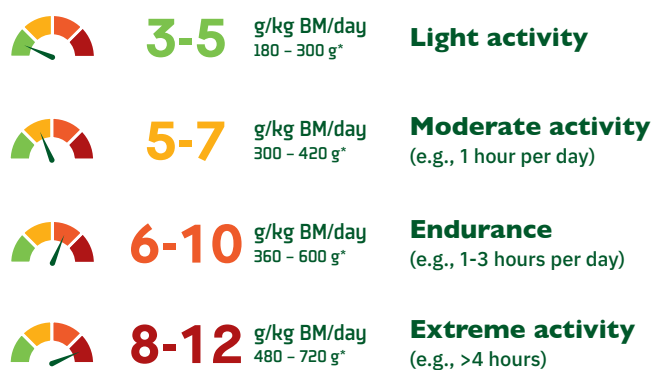


Figure 1: Substrate metabolism at rest and during different exercise types and intensities

## Daily carbohydrate recommendations

Due to carbohydrate utilization varying during different exercise occasions, daily carbohydrate intake recommendations are dependent upon the intensity and duration of exercise being performed (Figure 2). The aim is to ensure that sufficient carbohydrate is consumed to provide energy to working muscles, the central nervous system, and other bodily processes. Figure 3 shows the carbohydrate content of different foods which can contribute to overall daily carbohydrate intake.



\*Recommendations in grams (g) calculated for a 60 kg/132 lb female  
g/kg BM/day = grams per kg of body mass per day

Figure 2: Daily carbohydrate intake based on activity level



Figure 3: Carbohydrate and fiber content of foods and drinks

Table 1  
Daily carbohydrate intake recommendations based on exercise intensity and body mass

Body mass		Recommended carbohydrate intake (g) per day									
		3 g/kg BM/d	4 g/kg BM/d	5 g/kg BM/d	6 g/kg BM/d	7 g/kg BM/d	8 g/kg BM/d	9 g/kg BM/d	10 g/kg BM/d	11 g/kg BM/d	12 g/kg BM/d
kg	lb										
45	99	135	180	225	270	315	360	405	450	495	540
50	110	150	200	250	300	350	400	450	500	550	600
55	121	165	220	275	330	385	440	495	550	605	660
60	132	180	240	300	360	420	480	540	600	660	720
65	143	195	260	325	390	455	520	585	650	715	780
70	154	210	280	350	420	490	560	630	700	770	840
75	165	225	300	375	450	525	600	675	750	825	900
80	176	240	320	400	480	560	640	720	800	880	960
85	187	255	340	425	510	595	680	765	850	935	1020
90	198	270	360	450	540	630	720	810	900	990	1080
95	209	285	380	475	570	665	760	855	950	1045	1140
100	221	300	400	500	600	700	800	900	1000	1100	1200
105	232	315	420	525	630	735	840	945	1050	1155	1260
110	243	330	440	550	660	770	880	990	1100	1210	1320
















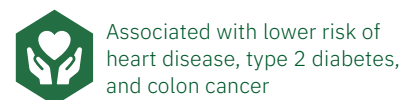
g/kg BM/day	Breakfast	Lunch	Dinner
 3-5	 Oatmeal with berries	 Chicken salad and a banana	 Fish with roasted vegetables
 5-7	 + a banana	 + bread rolls	 + a rice based salad
 6-10	 + yogurt and granola	 + a side of potatoes	 + a large glass of orange juice
 8-12	 + two slices of toast	 + a milk based fruit smoothie	 + a large fruit salad

Figure 4: Examples of how the carbohydrate content of meals can be altered to meet daily carbohydrate recommendations

## Dietary fiber

It is recommended for athletes to consume 25-35 grams of fiber per day. Dietary fiber provides many benefits to the body including:



While dietary fiber intake provides many health benefits, there is a reason for practitioners to be cautious if athletes regularly have a very high fiber intake (i.e., above the RDA, >35g fiber). Research in female endurance athletes found high levels of dietary fiber intake to be associated with low energy availability and functional hypothalamic amenorrhea (i.e., loss of menstrual cycle). These associations might be due to:

- 1 High fiber intake increasing fecal fat excretion, which in turn can reduce energy absorption
- 2 Dietary fiber increasing satiety, which when coupled with high-intensity exercise may suppress appetite, decrease hunger, and reduce the total amount of energy consumed during a meal
- 3 Excessive fiber increasing the likelihood of gastrointestinal discomfort e.g., bloating and diarrhea, which in turn may impact subsequent energy intake

**Therefore, while it is important for athletes to include fiber within their diet, practitioners should be aware of how much fiber female athletes are consuming. In addition, fiber intake should be limited before and during exercise to reduce the risk of gastrointestinal symptoms.**

## Do female athletes meet carbohydrate recommendations?

It has been shown that female athletes across a range of sports struggle to meet daily carbohydrate recommendations and do not adapt their carbohydrate intake based on their training load. This could be due to a number of reasons including:

- High consumption of low energy, nutrient dense carbohydrates (e.g., fresh fruits and vegetables)
- Body weight and/or composition fears
- Substituting sports drinks with low calorie sweetened drinks during high-intensity and/or prolonged exercise
- Lack of education regarding the importance of carbohydrates
- Negative perception of carbohydrates on social media

Meeting the upper end of the carbohydrate recommendations requires a large amount of food to be consumed, which may also be a contributing factor to female athletes not meeting the recommendations. For example, in food terms, 10 g/kg BM/day of carbohydrate for a 132 lb (60 kg) female (= 600g carbohydrate) is equivalent to either:



11 potatoes



1.8 kg white rice  
(uncooked)



1.7 kg pasta  
(uncooked)

\*It is not recommended to eat the amounts shown above in one day, a balanced diet is necessary



Excerpts from a qualitative study regarding carbohydrate intake in professional female soccer players bring to life some of the barriers faced by female athletes:



“It was quite difficult for me to actually transition into eating, like, more carbs and more calories because I was scared of putting weight back on. Sometimes I just don’t want to eat carbs because I know they will make me fat.”

– Player



“I’ve had conversations with players where I’m like ‘you need to have carbs at least on match day minus one, making sure you’re fueling for the game ahead’ and they’re a bit reluctant to want to take on that amount of carbs. Like ‘I don’t like eating that many carbs, that’s not something I do.’”

– Sports scientist



“The players don’t want a mixed protein shake, they just want a protein shake because the mixed protein shake has got too much carbs in and it’s like ‘wow, they’re not willing to have carbs after a game, that’s pretty scary’ I guess... The fact that they’re worried about some carbohydrate powder in a protein shake because they think it will make them fat is quite a scary thing.”

– Sports dietitian

McHaffie et al. (2022)

These excerpts highlight that providing education to female athletes regarding the role of carbohydrates in the diet is key. In addition, practitioners should work with female athletes on an individual basis to discuss any barriers that they face to meeting their daily carbohydrate needs, and to find ways to meet their individual carbohydrate recommendations.

## Low carbohydrate diets

Some athletes may purposefully follow a low carbohydrate diet on a long-term basis, i.e., a 'ketogenic' or 'low carbohydrate, high fat' diet. This may be for a range of reasons including a lack of understanding of the importance of carbohydrates for performance, fad diets, social media influence, "carb-phobia", perceived positive body composition outcomes, etc. Very low carbohydrate intake for a prolonged period can lead to a range of outcomes including:

- Premature fatigue during exercise
- Impaired performance at higher intensities
- Poor cognitive performance e.g., reduced alertness, difficulty concentrating
- Poor recovery between bouts of exercise

Athletes should therefore be educated around the potential performance consequences of following a low carbohydrate diet. It is however worth noting that a low carbohydrate diet may be useful

during very short-term periods (i.e., 3-7 days) where weight loss is required to meet a certain weight target e.g., Olympic weightlifting, wrestling, judo and boxing. This is because there is evidence that this is effective for reducing fat mass while maintaining power and strength during very short-term periods. If this strategy is used, it should be carefully planned and managed by a sports dietitian, and should not be used for long periods of time.



## Carbohydrate periodization

If athletes need help adjusting their carbohydrate intake to meet the demands of exercise on a day-by-day basis, carbohydrate periodization provides a practical solution. This strategy can help to support both performance and recovery through strategic timing of carbohydrate intake. Figure 5 provides a visual representation of how carbohydrate intake can be altered depending on the intensity and duration of exercise being completed.

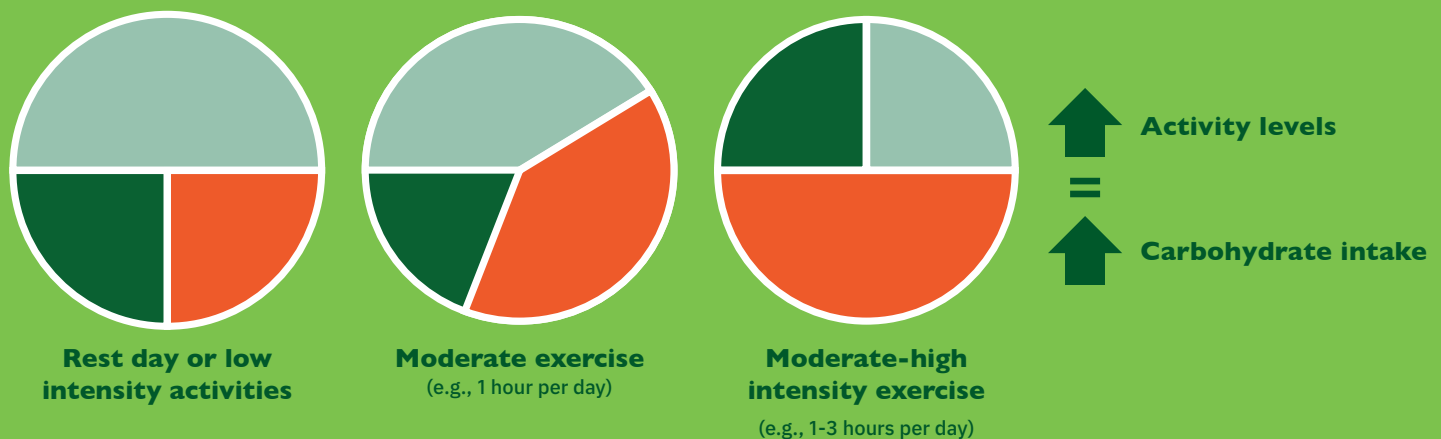


Figure 5: How to periodize carbohydrate intake based on activity levels

● Carbohydrate

● Fruit and veg

● Protein

## Should athletes alter carbohydrate intake based on menstrual cycle phase?

Popular media would suggest that female athletes should alter their diet, including their carbohydrate intake, during different phases of the menstrual cycle. **However, there currently is not enough research to back this statement.** There is some research to suggest that glycogen storage may be reduced during the follicular phase of the menstrual cycle compared to the mid-luteal phase. Nevertheless, providing that daily carbohydrate intake is sufficient for the exercise demands, this should not have an impact on performance.

# DIETARY CARBOHYDRATE



## Carbohydrate containing foods



**Sweet potatoes**  
1 cup = 30 g carbohydrate



**Standard potatoes**  
1 cup = 26 g carbohydrate



**Couscous**  
1 cup = 56 g carbohydrate



**Whole wheat pasta**  
1½ cups = 50 g carbohydrate



**Gatorade Thirst Quencher**  
20 oz (1 bottle) = 30 g carbohydrate



**Brown rice**  
1 cup = 46 g carbohydrate



**Banana**  
1 medium = 30 g carbohydrate



**Oats**  
½ cup = 30 g carbohydrate



**Wholegrain bread**  
2 slices = 30 g carbohydrate



**3-5**  
g/kg BM/day  
180 - 300 g

**Light activity**



**5-7**  
g/kg BM/day  
300 - 420 g

**Moderate activity**  
(e.g., 1 hour per day)



**6-10**  
g/kg BM/day  
360 - 600 g

**Endurance**  
(e.g., 1-3 hours per day)



**8-12**  
g/kg BM/day  
480 - 720 g

**Extreme activity**  
(>4 hr)

Examples based on a 60 kg/132 lb female



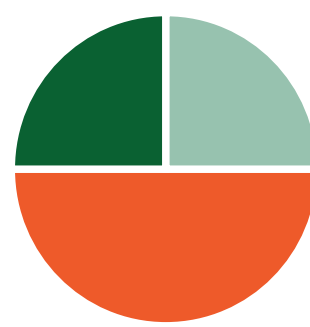
## Carbohydrate periodization



**Rest day or low intensity activities**



**Moderate exercise**  
(e.g., 1 hour per day)



**Moderate-high intensity exercise**  
(e.g., 1-3 hours per day)



Carbohydrate



Fruit and veg



Protein

## Carbohydrate intake and menstrual cycle phase

There is currently insufficient research to suggest that female athletes should alter their carbohydrate intake during different phases of the menstrual cycle. Female athletes should focus on ensuring that their carbohydrate intake is sufficient for their exercise demands, regardless of menstrual cycle phase.

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