Pre-exercise Fueling

for Female Athletes

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Introduction

Fueling optimally before training or competition will help athletes to perform at their best. It is important for female athletes to have knowledge of which types of foods are recommended to ingest before exercise, as well as which foods to limit. Pre-exercise nutrition strategies should be developed with athletes on an individual basis. It is recommended that athletes practice these strategies prior to training so that they know what works for them when it comes to a major competition, match or race. This will help athletes to feel confident in their choices so that they feel ready to perform at their best. The information below will explain key nutrition considerations for pre-exercise fueling to promote optimal performance in key training sessions or competition. It should be noted that currently, the recommendations for pre-exercise fueling do not differ between females and males.

Nutrition considerations: 1-2 days prior to exercise

Carbohydrate is stored in the body as glycogen, predominantly in the skeletal muscles and liver (Figure 1), however the body can only store a limited amount. During exercise, carbohydrates (in the form of glycogen and glucose) are often the main energy source for working muscles, with the contribution of carbohydrate to energy metabolism increasing as exercise intensity increases. It is important that athletes maximize their glycogen stores prior to exercise to provide working muscles with sufficient energy, which will help to delay fatigue and optimize performance. This is done by consuming carbohydrate-rich foods, and is particularly important prior to exercise that is of long duration and/or high intensity. The following information will discuss how athletes can optimize their glycogen stores prior to a key training session or competition (which will be referred to simply as 'exercise' from here onwards).

Figure 1: Glycogen storage within the body

Pre-exercise carbohydrate intake

Two strategies which can help to maximize glycogen stores in the 24-48 hours prior to exercise, and promote high carbohydrate availability during exercise, are:

1. **Rest/low intensity, short duration exercise**
2. **High carbohydrate intake**

For most sports, carbohydrate intakes of ~6-8 grams per kg of body mass (g/kg BM) for 24 hours prior to exercise, combined with adequate rest and recovery, will be sufficient to promote high carbohydrate availability during key training sessions/competition. In some cases, carbohydrate intakes of >8 g/kg BM may be required, such as for endurance type events lasting >90 minutes.

Table 1: Recommended carbohydrate intake for different types of activity

Type of activity	Recommended carbohydrate intake
Endurance events (lasting >90 mins)	**8-12 g/kg BM/day** 36-48 hours prior
Most sports	**6-8 g/kg BM/day** 24 hours prior

Practical solutions for increasing carbohydrate intake:

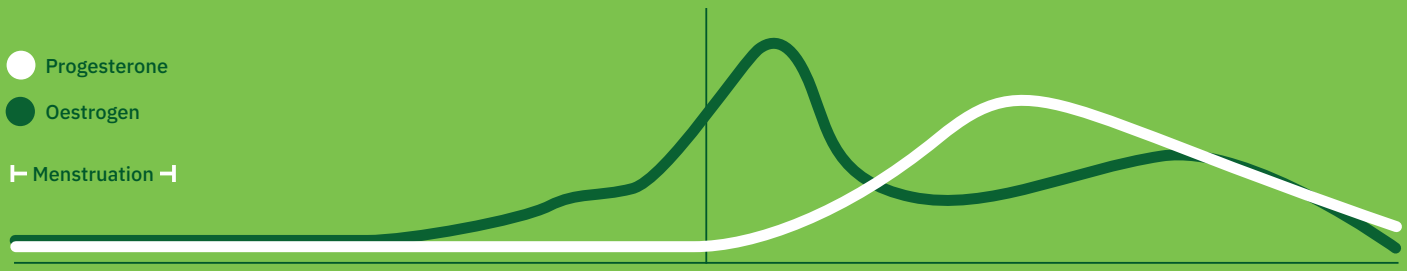
Achieving high carbohydrate intakes can be difficult for some female athletes, in particular for those who have habitual daily energy intakes <2000 kcal. Some practical solutions to help athletes increase their carbohydrate intake include:

- Consuming carbohydrate in liquid form e.g., smoothies, fruit juice, sports drinks, milk-based drinks
- Consuming 'simple' carbohydrates which are more easily digested e.g., white bread/pasta/rice
- Consuming small snacks often as opposed to large meals
- Including higher carbohydrate vegetables within meals e.g., potatoes, corn, parsnips, peas, squash
- Adding beans and legumes into meals e.g., lentils, black beans, pinto beans, kidney beans
- Consuming high carbohydrate snacks e.g., granola bars, bananas, rice cakes

Considerations

Muscle glycogen storage

There is some research, albeit limited, to suggest that females have lower muscle glycogen storage capacity than males. In addition, there may be differences in muscle glycogen storage during different phases of the menstrual cycle (Figure 2). If carbohydrate intake is high, similar levels of resting muscle glycogen concentration can be achieved between the different phases. It is currently unknown whether different forms of hormonal contraceptives impact muscle glycogen storage.



Follicular phase

There may be an increased risk of reduced resting muscle glycogen concentrations if carbohydrate intake is sub-optimal

Luteal phase

When carbohydrate intake is sub-optimal, glycogen storage appears to be more effective during this phase in comparison to the follicular phase

Figure 2: Muscle glycogen storage during the menstrual cycle

Liver glycogen

Liver glycogen stores are reduced by ~50% after an overnight fast, which is a key consideration if exercise start time is earlier in the day. This highlights the importance of optimal nutrition preparation the day prior to exercise, as well as the morning of.

Nutrition considerations: 1-4 hours prior to exercise

It is recommended for athletes to consume a carbohydrate rich meal containing 1-4 grams of carbohydrate per kg of body mass (g/kg BM) in the 1-4 hours before exercise begins (Table 2). The upper end of the recommendations is most relevant for long duration (>90 min), high-intensity endurance events where performance is the primary objective.

Table 2: Carbohydrate recommendations in the 1–4 hours prior to exercise, in relation to body mass

Body mass		Grams of carbohydrate			
kg	lb	1 g/kg BM	2 g/kg BM	3 g/kg BM	4 g/kg BM
45	99	45	90	135	180
50	110	50	100	150	200
55	121	55	110	165	220
60	132	60	120	180	240
65	143	65	130	195	260
70	154	70	140	210	280
75	165	75	150	225	300
80	176	80	160	240	320
85	187	85	170	255	340
90	198	90	180	270	360
95	209	95	190	285	380
100	221	100	200	300	400
105	232	105	210	315	420
110	243	110	220	330	440

Carbohydrate content of different foods, which could be consumed in the 1-4 hours pre-exercise:

Sweet potatoes
Serving size: 1 cup
Carbohydrate: ~30 g
Fiber: ~4 g

Standard potatoes
Serving size: 1 cup
Carbohydrate: ~26 g
Fiber: ~3 g

Couscous
Serving size: 1 cup
Carbohydrate: ~56 g
Fiber: ~5 g

Pasta
Serving size: 1½ cups
Carbohydrate: ~50 g
Fiber: ~7 g

Gatorade Thirst Quencher
Serving size: 20 oz (1 bottle)
Carbohydrate: ~30 g
Fiber: 0 g

Rice
Serving size: 1 cup
Carbohydrate: ~46 g
Fiber: ~3 g

Banana
Serving size: 1 medium
Carbohydrate: ~30 g
Fiber: ~2 g

Oats
Serving size: ½ cup
Carbohydrate: ~30 g
Fiber: ~4 g

Bread
Serving size: 2 slices
Carbohydrate: ~30 g
Fiber: ~5 g

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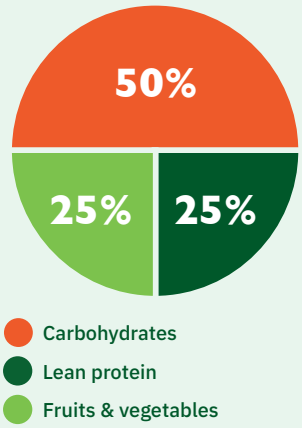
Achieving pre-exercise carbohydrate recommendations

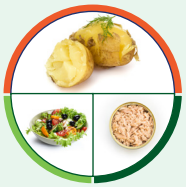
The pre-exercise carbohydrate recommendation of 1-4 g/kg BM encompasses a range, which allows for individual preferences. For example, if an athlete struggles to eat a large amount close to exercise then they may want to consume 2 g/kg BM carbohydrate ~3-4 hours before exercise. On the other hand, another athlete may prefer to have a large meal close to exercise, therefore they may consume 3 g/kg BM carbohydrate in the ~1-2 hours before exercise. Both strategies still meet the pre-exercise carbohydrate recommendations, while also catering for personal preferences. Figure 3 shows how the carbohydrate content of a meal can be adapted.

Figure 3: Meals containing 1–4 g/kg BM carbohydrate (based on a 132 lb / 60 kg female)

Guide for plate portion

In practical terms, an athlete's pre-exercise meal should have at least one source of good quality carbohydrate as a significant part (ideally at least 50%) of their meal. Some ideas for pre-exercise meals using this principle can be seen below:

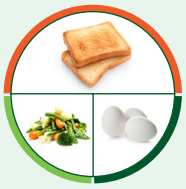




Baked potatoes with protein based topping and small salad

Rice with fish and vegetables

Pasta with protein and vegetable based sauce



Toast with eggs and roasted vegetables

Foods to limit or avoid?

High fat foods

Consuming high fat foods prior to exercise can cause stomach discomfort during exercise (e.g., bloating, gas, abdominal pain) because fat slows the rate at which food is emptied from the stomach. Encourage athletes to limit the amount of high fat food in their pre-exercise meal e.g., processed meats, fried foods, creamy sauces, cheese, and pastries.

High fiber foods

Consuming too much fiber prior to exercise may also cause stomach discomfort during exercise. This is because fiber is slow to empty from the stomach, which means that it takes the body longer to digest it. See Figure 4 for examples of foods high in fiber.


Wholegrain bread and cereals


Whole wheat pasta


Lentils


Brown rice


Beans


Raw vegetables

Figure 4: Examples of foods high in fiber

If an athlete experiences gastrointestinal symptoms when beginning exercise, choosing lower fiber foods (e.g., white bread/pasta/rice) in their pre-exercise meal may help to alleviate symptoms. It is important to note that fiber is a very important part of an athlete's diet. Therefore, even if an athlete experiences gastrointestinal symptoms during exercise, fiber should only be reduced strategically around exercise and not eliminated entirely from their diet.

Nutrition considerations: 60 minutes prior to exercise

In the hour prior to exercise, some athletes may wish to consume an additional snack. For example, this may be just before or just after their warm-up. It is recommended that this snack contains ~30-60 grams of easily digestible carbohydrates. For example:


Gatorade Thirst Quencher (20 oz)

21g carbohydrate


Large banana

~25-30g carbohydrate


Gatorade Gx pod (mixed with water)

21g carbohydrate


Single serve Gatorade Thirst Quencher powder (mixed with water)

34g carbohydrate


2 slices white bread with jam

~35g carbohydrate


3-4 rice cakes with honey

~30g carbohydrate

Options can be mixed and matched to meet carbohydrate recommendations

Top tips for pre-exercise fueling

- Encourage athletes to practice competition fueling around training sessions or lower priority competitions
- Focus on foods that are easily digestible to reduce the risk of gastrointestinal problems (e.g., bloating, discomfort, reflux)
- Tailor meal and snack options to meet individual preferences
- Provide education when athletes are travelling, as food options may not be as readily available
- Encourage athletes to consume familiar foods pre-exercise

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PRE-EXERCISE FUELING

1-2 days before

Endurance events
(lasting >90 mins)

8-12
g/kg BM/day
36-48 hours prior

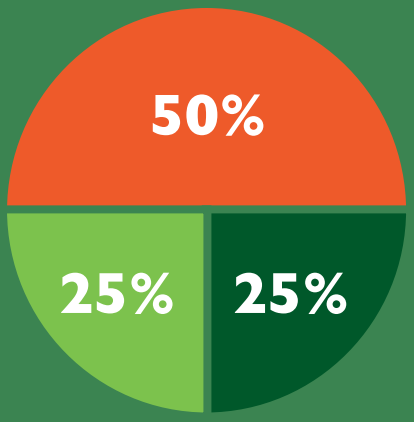
Most sports

6-8
g/kg BM/day
24 hours prior

1-4 hours before

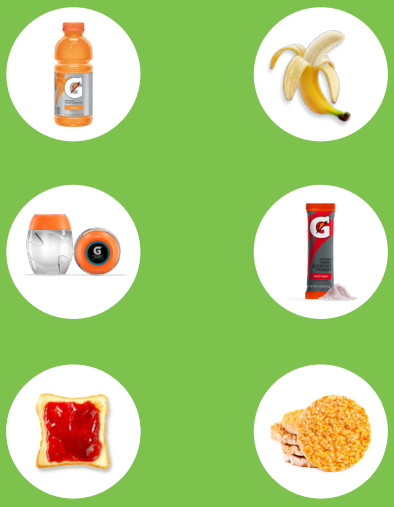
Meal containing 1-4 g of carbohydrate per kg of body mass

Carbohydrate content at least 50% of meal



60 min before

30-60 g of easily digestible carbohydrates



High carbohydrate options to include in pre-exercise meals


Sweet potatoes


Standard potatoes


Couscous


Pasta


Gatorade Thirst Quencher


Rice


Banana


Oats


Bread

Practical solutions for increasing carbohydrate intake in female athletes

- Consume carbohydrate in liquid form e.g., smoothies, fruit juice, sports drinks, milk-based drinks
- Consume small snacks often as opposed to large meals
- Add beans and legumes into meals e.g., lentils, black beans, pinto beans, kidney beans
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References and resources

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Carbohydrate: https://www.gssiweb.org/en/sports-science-exchange/All/carbohydrate