



FUELING ATHLETIC PERFORMANCE



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FOODS & FLUIDS FOR BASKETBALL



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Success in many sports relies on each individual doing his or her part on behalf of the team. Athletes set individual and team performance goals for the season, but rarely set nutrition goals. For example, one goal might be to arrive at practices hydrated and properly fueled in preparation to work hard. Good nutrition and hydration practices are one of several important behaviors that together can be key to successful individual performances.

Every team sport is different, and factors such as rules of play, frequency of games, length of season and position-specific requirements alter the nutritional plans. As a court sport, basketball is defined by a fairly small playing area, and the rules of the game allow for frequent substitutions. Tournament play with little recovery time is also common.⁵ Therefore, one of the greatest nutrition considerations is the consumption of adequate carbohydrate to maintain glycogen levels over the course of a practice or game to support the frequent high-intensity bursts of muscle activity.⁵

Basketball players should also focus on hydration before, during and after practices and games. The research literature suggests that basketball players' pregame hydration habits may be inadequate and players often begin practices and games dehydrated.⁹ During play, dehydration by $\geq 2\%$ of body weight has been found to impair basketball skill performance, and greater levels of dehydration can further degrade performance.² However, the rules of the game with frequent breaks and the accessibility of fluids on the sidelines should provide basketball players with ample opportunity to maintain hydration.

This guide provides an overview of sports nutrition guidelines for basketball, which should be adapted to individual athletes. It should be noted that off-season workouts and training programs likely require different considerations, based on the nature and goals of the off-season program. For example, a basketball player may have a goal to lose fat mass and gain lean mass in the off-season, which would require a different nutrition



strategy than during-season maintenance of lean mass. The recommendations below are focused on practices and games in the competitive season.

Suggested Daily Macronutrient Intake

(per kilogram of body weight)

Carbohydrate:⁵ 5-7 g/kg/day

Protein:¹ 1.2-1.7 g/kg/day

PRE-PRACTICE OR GAME FOODS & FLUIDS

Eating before a practice or game tops off the body's carbohydrate stores (called glycogen), especially if the workout or competition is in the morning. Carbohydrate is the primary fuel source for muscle contraction during both high- and low-intensity points of the game, so it is important athletes start practices and games with enough carbohydrate stored in their body.

The pre-event meal should be eaten ~1-4 hours before exercise, contain ~1-4 g/kg carbohydrate and be low in protein, fiber and fat to minimize the risk of gastrointestinal upset. The exact timing and amount of

carbohydrate consumed during this time should meet the individual preferences of the athlete.⁹ Additionally, it is recommended that athletes drink ~5-7 mL/kg of fluids with sodium approximately 4 hours prior to a workout or competition, and another 3-5 mL/kg about 2 hours prior if they cannot urinate or if the urine is dark.^{12, 13}

Ingesting carbohydrate within the hour prior to training or competition essentially begins to meet the athlete's during-exercise fueling needs,⁷ and may also help the athlete decrease feelings of hunger. The amount and form of carbohydrate, such as a beverage, chew or solid food, is the individual choice of the athlete.

Sample Pre-Practice/Game Meals

(Examples for a 250 lb [114 kg] athlete)

Menu #1

(~4 hours prior, target ~4 g/kg, 456 g carbohydrate)

- Large baked potato with 1 Tbsp fat-free sour cream
- 4 oz grilled chicken breast sandwich on a Kaiser roll with 1 Tbsp barbeque sauce
- 2 cups cooked white rice with 1 cup black beans, use butter sparingly
- 1/2 cup macaroni & cheese
- 20 oz grape juice
- 2 cups fat-free frozen yogurt with 1 cup sliced strawberries

Approximate totals: 2,445 calories, 476 g carbohydrate, 19 g fat, 125 g protein, 25 g fiber

Menu #2

(~3 hours prior, target ~3 g/kg, 342 g carbohydrate)

- Pasta (2.5 cups cooked) with 1.5 cups marinara sauce
- Medium piece French bread (~4 oz)
- 16 oz apple juice
- 1 cup vanilla fat-free pudding (not sugar free!) with 1/2 cup sliced banana

Totals: 1,610 calories, 336 g carbohydrate, 7 g fat, 43 g protein, 11 g fiber

Menu #3

(~2 hours prior, target ~2 g/kg, 228 g carbohydrate)

- Turkey sandwich
 - 4 oz low-fat deli turkey
 - Mustard/low-fat mayo (use mayo sparingly)
 - Plain bagel
- ~40 tiny twist pretzels
- 1 large apple
- 6 fig cookies
- 20 oz Gatorade

Totals: 1,096 calories, 234 g carbohydrate, 5 g fat, 32 g protein, 10 g fiber

G Series O1 Prime: designed to provide carbohydrate energy shortly before exercise

	Serving Size	Carbohydrate	Sodium
Pre-Game Fuel Pouch	1 pouch (4 fl oz)	25 g	110 mg
Energy Chews	6 chews	24 g	90 mg

Pre-Practice or Game Key Messages

- Basketball players should consume carbohydrate before a practice or game to ensure adequate carbohydrate is stored in the muscle. Carbohydrate is the primary fuel for both the high-intensity bursts of muscle contraction and prolonged muscle contractions that occur during “stop and go” activity.
- Adequate fluids should be consumed about 4 hours before a practice or game.



DURING-PRACTICE OR GAME FOODS & FLUIDS

Importance of Hydration

Basketball players spend several hours each day training, sometimes twice a day, and often in hot and humid gyms. Therefore, for both safety and performance, paying attention to hydration is important. Athletes should be sure to drink enough fluid to prevent dehydration without over-drinking. Dehydration may strain the cardiovascular system and increase body temperature, which increases the risk of heat illness.

Hydrate the Right Way

Since practices are often longer than games, especially early in the season, it is important to develop a hydration strategy for both practices and games. To determine an athlete's sweat rate, measure body weight before and after a training session in the same environment as a competition. Also keep track of all the fluid consumed. A rough estimate of sweat rate can be obtained by using the following equation: $\text{sweat rate (L/h)} = (\text{weight loss} + \text{fluid intake (L)}) / \text{exercise time (hours)}$. This measurement will likely need to be made several different times for practices and competitions, especially as the weather changes.

Sodium

Athletes sweat and sweat contains sodium. Consuming fluid with sodium, such as in a sports drink, is important because sodium helps maintain the physiological desire to drink and helps retain the fluid consumed.⁸ Athletes, especially when training or competing for more than 2 hours or those who have high sweat losses, should replace both fluid and sodium during exercise.¹³ Basketball players who are prone to cramping may have higher sweat sodium losses.^{6, 14} To estimate if an athlete is a "salty sweater," look for white residue on dark-colored clothing after a training session.

Answering "yes" to any of these questions may indicate inadequate hydration:

- Am I thirsty?
- Is my urine a dark yellow color?
- Is my body weight noticeably lower than yesterday?

Tips for Hydration

- Know your sweat rate in the environments where you will train and compete to customize a plan to meet your unique needs.
- Begin practices and games hydrated. Monitor your urine color; it should be a light yellow color (like lemonade) to indicate adequate hydration.
- Use sports drinks to provide fluid and electrolytes for hydration as well as carbohydrate for energy.

Carbohydrate

Consuming carbohydrate during exercise provides fuel to the muscle, brain and nervous system. Carbohydrate has been demonstrated to improve indices of performance in team sports.¹⁷ For example, in a study using a simulated basketball game, athletes who consumed carbohydrate throughout compared to water had 14% faster 20 m sprint time in the 4th quarter, improved motor skills in the second half, and decreased reported feelings of fatigue late in the "game."¹⁶ The recommended amount of carbohydrate ingestion every hour of exercise for a team sport athlete, including basketball players, is 30-60 g/h.^{1, 3, 5} The amount within this range may be tailored by the athlete's playing time and the form (solid, semisolid or liquid) should be determined by the preferences of the individual athlete.

Sodium and Carbohydrate Content of Gatorade O2 Perform Beverages

	Carbohydrate (g/8 oz)	Sodium (mg/8 oz)
G Series Gatorade Thirst Quencher	14	107
G Series G2	5	107
G Series Pro Endurance Formula	14	200
G Series Pro Gatorlytes	0	780 (mg/packet)

Examples of Strategies to Meet the 30-60 g/h Carbohydrate Recommendation

- 16 oz Gatorade Thirst Quencher = 28 g carbohydrate
- 32 oz Gatorade Thirst Quencher = 56 g carbohydrate
- 32 oz G2 plus G Series Pre-Game Fuel Pouch or 6 G Series Prime Energy Chews = 45 g carbohydrate

Plan ahead to take advantage of timeouts and halftime to refuel

During-Practice or Game Key Messages

- Basketball players should determine their individual sweat rate, taking into account equipment and environment, and consume fluids with sodium to minimize body weight changes during practices and games.
- Carbohydrate intake during exercise can help maintain performance in “stop and go” activities such as basketball; athletes should aim to consume 30-60 g (120-240 calories) per hour of practices or games.
- It is possible to train the gut! If athletes are currently consuming less than the recommendations, gradually increase intake to minimize gastrointestinal issues.





POST-PRACTICE OR GAME FOODS & FLUIDS

Restoring the carbohydrate used from the muscle and liver during both aerobic- and anaerobic-type muscle contractions is a key focus of the post-exercise fueling needs of basketball players. When athletes have less than 8 hours between practices or competitions, 1.0-1.2 g/kg carbohydrate should be consumed every hour for 4 hours. When athletes have more than 8 hours between sessions, they should follow daily carbohydrate needs for team sport athletes (5-7 g/kg/day) and choose carbohydrate-rich meals and snacks with some protein regularly throughout the day.^{3,5}

While consuming carbohydrate for recovery will help replenish energy stores in the muscle to help the athlete be ready for the next practice or game, eating protein is important to rebuild muscle and adapt to the demands of basketball, helping the athlete recover over the course of a long season. Athletes should consume about 20 g of protein to start the recovery process as soon as possible after each training session, practice and game to help rebuild muscle tissue as well as adapt to the demands of training. Choose a rapidly digested, complete protein rich in the amino acid leucine, such as milk, whey, meat or eggs.^{10, 18}

Following exercise, athletes should drink 20-24 oz per pound of body weight lost of fluid with sodium, to replace the amounts lost during training and competition.^{1, 5, 13}

Recovery Food and Fluid Examples (examples as a bridge to a full meal)

		Calories	Carbohydrate (g)	Fiber (g)	Protein (g)	Fat (g)	Sodium (mg)
Option 1	G Series Protein Recovery Shake <i>Water (amount based on body weight changes)</i>	270	45	1	20	1.5	320
Option 2	Gatorade Recover Whey Protein Bar <i>Water (amount based on body weight changes)</i>	340-370	42-43	1-2	20	9-12	160-210
Option 3	G Series Recover Beverage <i>Additional water if needed based on body weight changes</i>	230	41	0	16	0	220
Option 4	Beef jerky (1 oz) & 10 saltine crackers <i>Additional water if needed based on body weight changes</i>	200	25	0	18	4	982

Post-Practice or Game Key Messages

- Restore carbohydrate after practices and games to replace used glycogen (carbohydrate stored in the muscle and liver) and to store more glycogen as an adaptation to training.
- Athletes should consume ~20 g of high-quality protein as soon as possible following training or competition to help rebuild muscle tissue.
- Rehydrate with 20-24 oz of fluid with sodium for every pound of body weight lost during exercise.





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AN EXAMPLE: PUTTING THE SCIENCE-BASED RECOMMENDATIONS INTO PRACTICE

Athlete Profile

Name: Mike

Age: 17

Weight: 170 lbs (77 kg)

Type of athlete: Boys high school basketball player

Goal: To determine a fueling strategy for games

Background: Mike is the starting point guard for his high school basketball team and averages 30 minutes per game. He is looking for some help to maintain his energy levels in the fourth quarter.

Pre-Game

We want to make sure Mike eats adequate carbohydrate before the game to top off the stores in his muscle (called glycogen), since glycogen is an important fuel source during a basketball game. Weeknight games start at 7:30 and school ends at 4:00. Since Mike doesn't like to eat too close to the start of a game, he will need to eat his pre-game meal about 3 hours before game time. We recommend he then follow the same timing for weekend games. Aiming for ~3 g of carbohydrate per kilogram of body weight and taking into account his favorite foods, we designed a meal to deliver 231 g of carbohydrate. Mike likes to eat the same thing before every game so he knows how his stomach will react and has a superstition about eating red gelatin before a game, so we incorporated that into his pre-game meal.

In the past, Mike usually ate his favorite food, pepperoni pizza, with the red gelatin before a game. In order to help stay closer to his traditional food but provide more carbohydrate and less fat, we suggested a homemade pizza bread, with French bread (1/3 loaf), pizza sauce (1/2 cup) and a small amount of shredded mozzarella cheese (~2/3 cup). With that he had a 20-oz Gatorade Thirst Quencher to meet his fluid needs (385-539 mL, or 13-18 oz) and provide additional carbohydrate. We also made sure his red gelatin (~1/2 cup) was NOT sugar-free, to ensure he was getting enough carbohydrate. The nutritional totals for this meal are approximately 1,306 calories, 240 g carbohydrate, 49 g protein, 18 g fat and 6 g fiber.

Mike gets fairly nervous before a game so he doesn't think about eating again but does feel like he could use a little energy at the start of the game. During practices we had him try a Gatorade Prime Sports Fuel Drink shortly before starting to give him some extra carbohydrate energy. The pouch was a bit too much liquid for him, so we had him try three Gatorade Prime Energy Chews (a serving of six is equivalent to the carbohydrate in one Gatorade Prime Sports Fuel Drink). This strategy didn't upset his stomach, so now Mike's pre-game ritual includes three chews and some water while listening to coach in the locker room.

During the Game

To determine Mike's sweat rate, we attended a practice when the team was scrimmaging to simulate the game situation as closely as possible. We weighed him before and after practice, and measured his fluid intake. Based on that information, we've estimated Mike's sweat rate to be 1.5 L/h (51 oz/h), which is fairly high. Mike doesn't report any issues with cramping and we didn't observe salt on his dark green clothing during the practice, so he likely doesn't have higher than average sodium needs.

Carbohydrate intake throughout the game is going to be important for Mike to help maintain energy level in the fourth quarter. Not to mention, research shows carbohydrate intake during a simulated basketball game, as well as maintaining hydration, helps skills such as free throw shooting.⁴ Therefore, it will be important for us to help Mike consume close to the upper end of the 30-60 g/hour recommendation.

Mike averages 30 minutes of playing time and a high school basketball game usually lasts a little over an hour. Since Mike has high fluid needs, we suggested he try to consume one 32-oz and one 20-oz bottle of Gatorade G2 over the course of a game, which will provide 52 oz of fluid to match his sweat rate and 32 g of carbohydrate. Since we want him to be a little closer to 60 g of carbohydrate, we will also have him eat Gatorade Prime Energy Chews at halftime to provide an additional 25 g of carbohydrate, for a total over the course of the game of 57 g. It is important that Mike practices this amount of fluid and carbohydrate intake and plans ahead to take advantage of every timeout, break between quarters and halftime to refuel and rehydrate.

After the Game

Good recovery practices can help an athlete persist through a long season like basketball. Since Mike plays a lot of minutes, we want to make sure he recovers well after each practice and game. Mike reports feeling very hungry after games, so we recommend he drink the Gatorade Recover Protein Shake or eat the Gatorade Recover Whey Protein Bar to get 20 g of protein to rebuild muscle, carbohydrate to replace the stores in his muscles and electrolytes to help replace sodium lost in sweat. The

total amount of carbohydrate he eats at this point isn't of great importance since Mike's next practice isn't until after school the next day and this shake will serve as a bridge to his next meal (which should contain ample carbohydrate). It will be easy for him to drink the shake or eat the bar while he is icing down after the game. Also, since every game is different, we recommend he weigh himself before and after each game and drink his shake, as well as drink ~20 oz of water for every pound of body weight lost.

References:

- (1) American College of Sports Medicine. Academy of Nutrition and Dietetics, Dietitians of Canada. (2016). Nutrition and athletic performance. *Medicine and Science in Sports and Exercise*, 48, 543-568.
- (2) Baker, L.B., K.A. Dougherty, M. Chow, and W.L. Kenney (2007). Progressive dehydration causes a progressive decline in basketball skill performance. *Med. Sci. Sports Exerc.* 39:1114-1123.
- (3) Burke, L., Hawley, J., Wong, S., & Jeukendrup A. (2011). Carbohydrates for training and competition. *Journal of Sports Sciences*, 29 Suppl 1, S17-27.
- (4) Dougherty, K., Baker, L., Chow, M., & Kenney, W. (2006). Two percent dehydration impairs and six percent carbohydrate drink improves boys basketball skills. *Medicine and Science in Sports and Exercise*, 38, 1650-1658.
- (5) Holway, F. & Spriet, L. (2011). Sport-specific nutrition: Practical strategies for team sports. *Journal of Sports Sciences*, 29 Suppl 1, S115-125.
- (6) Horswill, C., Stofan, J., Lacambra, M., Toriscelli, T., Eichner, E., & Murray, R. (2009). Sodium balance during U.S. football training in the heat: cramp-prone vs. reference players. *International Journal of Sports Medicine*, 30, 789-794.
- (7) Jeukendrup, A. & Killer, S. (2010). The myths surrounding pre-exercise carbohydrate feeding. *Ann Nutr Metab.* 57 Suppl 2, 18-25.
- (8) Maughan RJ and Murray R. *Sports Drinks: Basic Science and Practical Aspects*, Boca Raton, FL: CRC Press. 2001;7-8:183-224.
- (9) Osterberg, K.L., C.A. Horswill and L.B. Baker (2009). Pregame urine specific gravity and fluid intake by National Basketball Association players during competition. *J. Athl. Train.* 44:53-57.
- (10) Phillips, S. & Van Loon, L. (2011). Dietary protein for athletes: from requirements to optimum adaptation. *Journal of Sports Sciences*, 29 Suppl 1, S29-38.
- (11) Res, P., Groen, B., Pennings, B., Beelen, M., Wallis, G., Gijzen, A., Senden, J., & Van Loon, L. (2012). Protein ingestion before sleep improves postexercise overnight recovery. *Medicine and Science in Sports and Exercise*, 44, 1560-1569.
- (12) Sawka, M. N., Burke, L. M., Eichner, E. R., Maughan, R. J., Montain, S. J., & Stachenfeld, N. S. (2007). American College of Sports Medicine position stand: Exercise and fluid replacement. *Medicine and Science in Sports and Exercise*, 39, 377-390.
- (13) Shirreffs, S., & Sawka M. (2011). Fluid and electrolyte needs for training, competition, and recovery. *Journal of Sports Sciences*, 29 Suppl 1, S39-46.
- (14) Stofan, J., Zachwieja, J., Horswill, C., Murray, R., Anderson, S., & Eichner, E. (2005). Sweat sodium losses in NCAA football players: a precursor to heat cramps? *International Journal of Sport Nutrition and Exercise Metabolism*, 15, 641-652.
- (15) Snijders, T., Res, P., Smeets, J., Van Vliet, S., Van Kranenburg, J., Maase, K., Kies, A., Verdijk, L., & Van Loon, L. (2015). Protein ingestion before sleep increases muscle mass and strength gains during prolonged resistance-type exercise training in healthy young men. *Journal of Nutrition*, 145, 1178-1184.
- (16) Welsh, R., Davis, J., Burke, J. and Williams, H. (2002). Carbohydrates and physical/mental performance during intermittent exercise to fatigue. *Med Sci Sports Exerc.* 34:723-731.
- (17) Winnick, J., Davis, JM., Welsh, R., Carmichael, M., Murphy E., & Blackmon, J. (2005). Carbohydrate feedings during teams sport exercise preserve physical and CNS function. *Medicine and Science in Sports and Exercise*, 37, 306-315.
- (18) Witard, O., Jackman, S., Breen, L., Smith, K., Selby, A., & Tipton, K. (2014). Myofibrillar muscle protein synthesis rates subsequent to a meal in response to increasing doses of whey protein at rest and after resistance exercise. *American Journal of Clinical Nutrition*, 99, 86-95.



CALCULATIONS/YOUR WORKSHEET

1. BODY WEIGHT

For many calculations, you need to know your body weight in kilograms. To do this calculation:

$$\text{Body weight in pounds} \text{ _____} / 2.2 = \text{ _____} \text{ kg}$$

2. DAILY MACRONUTRIENT NEEDS

Carbohydrate

$$\text{ _____ body weight (kg) * 5 g/kg = _____ grams per day}$$

TO

$$\text{ _____ body weight (kg) * 7 g/kg = _____ grams per day}$$

Protein

$$\text{ _____ body weight (kg) * 1.2 g/kg = _____ grams per day}$$

TO

$$\text{ _____ body weight (kg) * 1.7 g/kg = _____ grams per day}$$

Amounts within these ranges should be determined based on the requirements of the individual sport and athlete

3. BEFORE-EXERCISE CARBOHYDRATE NEEDS

A. Enter the time before exercise you like to eat (1-4 hours): _____ (h)

B. Enter your desired amount of carbohydrate (1-4 g/kg body weight): _____ (g)

C. **Pre-exercise carbohydrate intake** = _____ body weight (kg) * _____ carbohydrate amount from line 2 (g/kg) = _____ g carbohydrate

4. BEFORE-EXERCISE FLUID NEEDS

A. 4 hours prior to exercise:

$$\text{ _____ body weight (kg) * 5 mL/kg = _____ mL}$$

TO

$$\text{ _____ body weight (kg) * 7 mL/kg = _____ mL}$$

B. 2 hours prior to exercise (if needed):

$$\text{ _____ body weight (kg) * 3 mL/kg = _____ mL}$$

TO

$$\text{ _____ body weight (kg) * 5 mL/kg = _____ mL}$$

To convert mL to oz: _____ mL * 0.03 = _____ fluid oz

5. DURING-EXERCISE CARBOHYDRATE NEEDS

The recommendation is 30-60 g/hour, no calculation needed. Amount should be determined based on the requirements of the individual sport and athlete.

6. DURING-EXERCISE FLUID NEEDS

A. Pre-exercise weight = _____ lbs

B. Fluid consumed during exercise = _____ L

(_____ fluid oz / 33.8 = _____ L)

C. Post-exercise weight = _____ lbs

D. **Weight change** = Pre-exercise weight _____ lbs - Post-exercise weight _____ lbs =

E. Exercise time = _____ hours

F. **Sweat rate** = (Weight change _____ + Fluid intake _____ L) / _____ hours = L/h

7. POST-EXERCISE CARBOHYDRATE NEEDS (WHEN <8 HOURS RECOVERY)

body weight _____ (kg) * 1 g/kg = g carbohydrate

TO

body weight _____ (kg) * 1.2 g/kg = g carbohydrate

8. POST-EXERCISE FLUID NEEDS

Weight lost = Pre-exercise weight _____ lbs - Post-exercise weight _____ lbs =

Fluid needs:

_____ body weight lost * 16 oz = oz

TO

_____ body weight lost * 24 oz = oz

9. POST-EXERCISE PROTEIN NEEDS

About 20 g is appropriate for most athletes; however, to calculate your individual needs use this equation:

body weight _____ (kg) * 0.25 - 0.3 g/kg = g protein