GATORADE SPORTS SCIENCE INSTITUTE®

FOODS & FLUIDS FOR INDOOR VOLLEYBALL







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Success in many sports relies on each individual athlete doing their 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, volleyball is defined by a fairly small playing area, and the rules of the game allow for frequent substitutions. Therefore, one of the greatest nutrition considerations is the consumption of adequate carbohydrate to maintain glycogen levels (energy stores) over the course of a practice or game to support the frequent high-intensity bursts of muscle activity.[1]

This guide provides an overview of sports nutrition guidelines for indoor volleyball, which should be adapted to individual athletes' needs. 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 volleyball player may have a goal to 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.

PRE-PRACTICE OR GAME FOODS & FLUIDS

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 bodies. 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.

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.[2,4] 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.[5,6]

Ingesting carbohydrate within the hour prior to training or competition essentially begins to meet the athlete's during-exercise fueling needs,[2,4] 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.

SUGGESTED MACRONUTIRENT INTAKE

(per kilogram of body weight)

Carbohydrate:[2] 5-7 g/kg/day

Protein:[2,3] 1.2-2.0 g/kg/day



CARBOHYDRATE ENERGY FOR TRAINING AND COMPETITION

Product	Serving Size	Carbohydrate (g)	Sodium (mg)
Gatorade Energy Chews	6	25	70

PRE-PRACTICE OR GAME KEY MESSAGES

- Volleyball 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.
- Drink 5-7 ml/kg (2.3-3.1 oz/lb) of fluid with sodium starting about 4 hours before a practice or game.



SAMPLE PRE-PRACTICE/GAME MEALS

(Examples for a 140 lb [64 kg] athlete)

Menu #1

(~4 hours prior, target ~4 g/kg carbohydrates, 256 g carbohydrate)

- Penne pasta (2 cups cooked) with 1 cup marinara sauce
- Medium piece French bread (~4 oz)
- 16 oz orange juice
- 1 cup vanilla fat-free pudding (not sugar free!) with 1 cup sliced strawberries

Totals: 1,286 calories, 256 g carbohydrate, 9 g fat, 31 g protein, 11 g fiber

Menu #2

(~3 hours prior, target ~3 g/kg carbohydrates, 192 g carbohydrate)

- Turkey sandwich
  - 3 oz fat-free deli turkey
  - Mustard/low-fat mayo (use sparingly)
  - Plain bagel
- ~40 tiny twist pretzels
- 1 large apple
- 2 fig cookies
- 20 fl oz Gatorade Endurance Formula

Totals: 890 calories, 189 g carbohydrate, 5.5 g fat, 29 g protein, 9.5 g fiber

Menu #3

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

- 1 bakery-size bagel with 2 tsp low-fat cream cheese
- 1 large banana
- 20 fl oz Gatorade Endurance Formula

Totals: 550 calories, 125 g carbohydrate, 3.5 g fat, 11 g protein, 5 g fiber

DURING-PRACTICE OR GAME FOODS & FLUIDS

IMPORTANCE OF HYDRATION

Volleyball players spend several hours each day training, sometimes in hot and humid gyms. Therefore, for both the safety and performance, paying attention to hydration is important. Athletes should be sure to drink enough fluid to prevent dehydration without overdrinking. It is generally accepted that dehydration of a ~2% or more decrease in body weight (approximately a 3 lb loss in a 150 lb athlete) may negatively affect an athlete's performance.[5] Excessive dehydration may strain the cardiovascular system and increase body temperature, which increases the risk of heat illness. Unpublished data from GSSI conducted sweat testing revealed that mean fluid loss in female collegiate volleyball players was 0.57 L/h (0.3-1.1 L/h) and players had a -1% body mass change during testing. This was similar to data published on adolescent female court volleyball players with a mean sweat rate of 0.6L/h and a -0.4% change in body mass.[7]

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

- Am I thirsty?
- Is my urine a dark yellow color (like apple juice)?
- Is my body weight noticeably lower than yesterday?

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: ***sweat rate (L/h) = (weight loss (lbs) + fluid intake (L))/exercise time (hours)***. This measurement will likely need to be made several different times for practices and competitions, especially as the weather changes. Reference the Sweat Rate Calculator on page 10.

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.[8,9] 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.[2,5,6] To estimate if an athlete is a "salty sweater," look for white residue on dark-colored clothing after a training session.

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.
- Rehearse your game-day strategy during team practices and make sure you can tolerate the fluids without problems.
- Use sports drinks to provide fluid and electrolytes for hydration as well as carbohydrate for energy.

CARBOHYDRATE

Carbohydrate has been demonstrated to improve indices of performance in team sports, particularly intermittent high-intensity exercise capacity.[10,11] Consuming carbohydrate during practices and games provides fuel to the muscle, brain and nervous system.[11] The recommended amount of carbohydrate ingestion every hour of exercise for a team sport athlete, including volleyball players, is 30-60 g/h.[1,3,13] The amount within this range may be tailored by the demands of each position and the form (solid, semisolid or liquid) should be determined by the preferences of the individual athlete.

CARBOHYDRATE AND SODIUM CONTENT OF GATORADE PRODUCTS

Product	Carbohydrate (g/12 oz)	Sodium (mg/12 oz)
Gatorade Thirst Quencher	22	160
Gatorade Lower Sugar	5	160
Gatorade Endurance Formula	21	310
Gatorade Zero	<1	160
Gatorade Endurance Gatorlytes*	0	780**
Gatorlyte	9	300

** Gatorade Endurance Gatorlytes to be added to 20 oz Gatorade Thirst Quencher RTD.*

*** Per Gatorade Endurance Gatorlytes packet.*

EXAMPLES OF STRATEGIES TO MEET THE 30-60 G/H CARBOHYDRATE RECOMMENDATION

- 20 oz Gatorade Thirst Quencher = 36 g carbohydrate
- 12 oz Gatorade Thirst Quencher + 6 Gatorade Energy Chews = 47 g carbohydrate
- 28 oz Gatorade Thirst Quencher = 51 g carbohydrate

Plan ahead to take advantage of time between sets and during timeouts to refuel.



DURING-PRACTICE OR GAME KEY MESSAGES

- Indoor Volleyball players should determine their individual sweat rate 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 volleyball; athletes should aim to consume 30-60 g (120-240 calories) per hour of practice 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

In-season recovery nutrition should support the daily energy and hydration needs of the athlete while helping the muscles withstand the rigors of a long season. Nutrients and fluids consumed throughout the time between practices and games support recovery; highlighted here are the specific recommendations for the immediate recovery period.

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 indoor volleyball 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 the daily carbohydrate needs for team sport athletes (5-7 g/kg/day) for moderate training, 6-10 g/kg/d during periods of heavy training and choose carbohydrate-rich meals and snacks with some protein regularly throughout the day.[1,2]

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 indoor volleyball, helping the athlete recover over the course of a long season. Athletes should consume about 20-40 g[12] or 0.25-0.3 g/kg[13] 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.[13,14] Research is emerging on the use of plant-based proteins for recovery and muscle gain. Athletes consuming plant- based proteins should ensure they are eating a variety of foods in order to meet their essential amino acid needs to support recovery and training adaptations.[15]

Following practices and games, 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.[2,5]

RECOVERY OPTIONS

Product	Calories	Carbohydrate (g)	Fiber (g)	Protein (g)	Fat (g)	Sodium (mg)
Muscle Milk Pro Protein Shake 14 fluid ounces	240-250	14-15	<1-2	42	2-2.5	310-350
Muscle Milk Pro Protein Shake 11 fluid ounces	190-200	11-12	<1-2	33	1.5-2	250-280
Muscle Milk Protein Shake 14 fluid ounces	170	13	1-2	26	1-1.5	290-330
Muscle Milk Protein Shake 11 fluid ounces	160	10-11	<1-2	26	1-1.5	240-270
Gatorade Recover Protein Bar	330-360	39-43	0-2	20	10-13	160-310

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 ~20-25 g, or 0.25-0.3 g/kg of high-quality protein as soon as possible following training or competition to help rebuild muscle tissue.
- Rehydrate with 20-24 fl oz of fluid with sodium for every pound of body weight lost during exercise.



FEMALE SPECIFIC CONSIDERATIONS

Volleyball players will expend a significant amount of energy through undertaking intense training loads and competitive games. To support optimal health and performance, it is important that athletes consistently meet their energy needs, to ensure that their bodies have sufficient energy available to carry out vital physiological processes. If an athlete does not fuel their body well adequately, it can result in what is known as 'low energy availability' (LEA). Research suggests that LEA is more common among female athletes than their male counterparts.[16] A study involving female varsity volleyball players found that 20% were experiencing LEA.[17] In addition, it was demonstrated that female players were expending ~500 kcal during practices, ~400 kcal during game warm-ups, and ~850 kcal during games. Given these high energy demands, it is important that female volleyball players adopt effective nutrition strategies to meet their energy demands.

AN EXAMPLE: PUTTING THE SCIENCE-BASED RECOMMENDATIONS INTO PRACTICE



ATHLETE PROFILE

Name: Angela

Age: 20

Weight: 155 lbs (70.5 kg)

Type of athlete: Collegiate Volleyball Player

Goal: To determine a fueling strategy for games

Background: Angela is an opposite hitter for her team and is part of the starting lineup. She is looking for some help to maintain energy in the third, fourth and sometimes 5th set of her games.

PRE-GAME

We want to make sure Angela eats adequate carbohydrate before the game to top off the stores in her muscle (called glycogen), since glycogen is an important fuel source during a volleyball game. Weeknight games start at 7:00 PM and Angela needs to be to the locker room by 5pm after a full day of classes. Since Angela doesn't like to eat too close to the start of a game, she will need to eat her pre-game meal about 3 hours before game time. Aiming for ~3 g of carbohydrate per kilogram of body weight and considering her favorite foods, we designed a meal to deliver 212 g of carbohydrate. Angela can be superstitious and likes to eat the same thing before every game so she knows how her stomach will react and must eat fruit snacks before a game, so we incorporated that into her pre-game meal ritual.

In the past, Angela usually ate her favorite food, pepperoni pizza, with fruit snacks before a game. To help stay closer to her traditional food but provide more carbohydrate and less fat, we suggested homemade pizza bread, with 4 medium thickness slices of French bread, pizza sauce (1/2 cup) and part-skim shredded mozzarella cheese (~1/2 cup) plus a medium banana. With that, she can drink a 12-oz Gatorade Thirst Quencher and 4 oz water if desired to meet her fluid needs (352-493 mL, or 12-17 fl oz) and provide additional carbohydrate.

Angela gets fairly nervous before a game so she doesn't think about eating again but does feel like she could use a little energy at the start of the game. Her typical fruit snacks are actually not a bad choice as a carbohydrate source. We took this opportunity to incorporate her superstitious snack. She now has her fruit snacks after warm-ups while listening to her coach in the locker room.

DURING THE GAME

To determine Angela's sweat rate, we attended a practice when the team was scrimmaging to simulate the game situation as closely as possible. We weighed her before and after practice and measured her fluid intake. Based on that information, we've estimated Angela's sweat rate to be 0.8 L/h (~27 fl oz/h). Angela doesn't report any issues with cramping, nor does she typically observe salt on her compression clothing following practice, so she likely has average sodium needs. Carbohydrate intake throughout the game is going to be important for Angela

to help maintain her energy level in the later sets. It will be important for us to help Angela consume carbohydrate, particularly following the 30-60 g/hour recommendation.

Angela plays the majority of each match, which generally last between 90-120 minutes. Since Angela has moderate fluid needs, we suggested she try to consume one 28 oz bottle of GTQ over the course of a game, which will provide up to 28 oz of fluid and 51 g of carbohydrate total. Between sets, she can eat a sleeve of Gatorade chews to take in an additional 21 g of carbohydrate. It is important that Angela works up to this amount of fluid and carbohydrate intake by trying it in practice. She can incorporate this strategy during games by sipping on this fluid during line changes and in between periods. This will help her to maintain energy throughout the match.

AFTER THE GAME

Good recovery practices can help an athlete persist through a rigorous volleyball season. Since Angela plays a lot of minutes, we want to make sure she recovers well after each practice and game. Angela's hunger can vary after games, so we recommend she drink the Muscle Milk Protein Shake or eat the Gatorade Recover Protein Bar to get 20 g of protein to start to rebuild muscle, carbohydrate to replace the glycogen stores in her muscles, and electrolytes to help replace sodium lost in sweat. The total amount of carbohydrate she eats at this point isn't of great importance since Angela's next practice isn't for another 24 hours and this shake will serve as a bridge to her next meal. It will be easy for her to drink the shake or eat the bar while she is cooling down or getting a short recovery work out after the game. Also, since every game is different, we recommend that she weigh herself before and after each game and drink her shake, as well as drink ~20-24 oz of water for every pound of body weight lost. When she does get to her post-game meal, it should contain high-quality protein, carbohydrate, and be lower in fiber and fat.

Any opinions or scientific interpretations expressed in this document are those of the author and do not necessarily reflect the position or policy of PepsiCo, Inc.

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CALCULATIONS/YOUR WORKSHEET

1. BODY WEIGHT

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

Body weight in pounds _____ / 2.2 = [ ] kg

2. DAILY MACRONUTRIENT NEEDS

Carbohydrate:

_____ body weight (kg) * 5 g/kg = [ ] grams per day

TO

_____ body weight (kg) * 7 g/kg = [ ] grams per day

Protein:

_____ body weight (kg) * 1.2 g/kg = [ ] grams per day

TO

_____ body weight (kg) * 2.0 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:

_____ body weight (kg) * 5 mL/kg = [ ] mL

TO

_____ body weight (kg) * 7 mL/kg = [ ] mL

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

_____ body weight (kg) * 3 mL/kg = [ ] mL

TO

_____ 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 * 20 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 g = [ ] g protein

TO

Body weight _____ (kg) * 0.3 g = [ ] g protein


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