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Robert P. Nickell, Rph.

MISSION STATEMENT

THE PURPOSE

Brandon K. Welch, Pharm.D.
Founder of Pharmacy Athlete

The Sports Pharmacy magazine exists to empower a community of pharmacist professionals to optimize their impact through disseminating evidence-based knowledge and applied science on sports performance supplements and nutrition. Pharmacists can be pivotal players in the arena of sports. They are poised to help intersect biochemistry with biomechanics and real-life science with athletic performance. Our patient athletes rely on results and we are here to deliver them in real-time.

> Where Pharmacists unlock biochemistry to intersect with biomechanics to optimize patient human performance
>
> Brandon K. Welch, PharmD.

Contents

Nutritional Periodization for Strength Athletes

By Dr. Brandon Welch, Pharm.D., M.S.(c)

AUTHOR BIO:

Dr. Brandon Welch is an experienced licensed pharmacist that holds his doctorate in pharmacy from the University of South Florida and his bachelor degree in biomedical sciences with a focus in biochemistry. His passion in performance training led him to pursue his Master's degree in physiology and kinesiology with a concentration in human performance and athletic development. His expertise lies in functional training, sports nutrition, sports medicine, genetic counseling, and sleep therapy. He utilizes science based medicine and literature to help maximize his clients training performance and daily lifestyle. He's worked with several clients, helping them lose weight, improve performance, improve their sleep cycle, muscle building, and appropriate nutrient supplementing.

Periodization has long been used as a way to shape exercise programs and enhance performance adaptations in athletes. Combining short-, medium-, and long-term planning, periodization optimizes training-driven alterations while also providing the athlete with strategies for rest and recovery.

Exercise stimuli is vital for sports performance, but nutrition also plays an essential role in sport and body composition goals, and it is important not to underestimate how our body's fuel can impact our performance.

What is Nutritional Periodization?

Nutritional periodization refers to the planned, purposeful, and strategic use of specific nutritional interventions to enhance the adaptations that individual exercise sessions or periodic training plans target. Additionally, nutritional periodization may also seek to obtain other effects that improve long-term performance.[3]

Essentially, nutritional periodization is used to fuel the body based on the planned exercises, going on a day-by-day manner. This helps to meet the energy fluctuations and goals of each training session, allowing you to train harder, achieve your body composition goals, and recover more fully.

Applications for Strength Athletes

In the past, nutritional periodization has been targeted toward endurance athletes. However, Mota et al. sought to highlight nutritional strategies that instead benefit strength and power athletes and the specific nutritional concerns these athletes face in the article *Nutritional Periodization: Applications for the Strength Athlete*.

While nutritional periodization is referenced minimally in literature, the same cannot be said about the connection between nutrition and athletic performance. In fact, the literature is flooded with studies showing the potential links between carbohydrate and protein consumption and athletic performance.[2, 4-10]

Carbohydrates are essential for endurance sports because of their role in aerobic energy production[7, 8] and strength training.[9, 11]

Protein is also important for athletes because amino acids are needed in increasing amounts when maintaining, growing, and remodeling tissues.[2, 6, 8, 12, 13]

Nutritional periodization for strength athletes focuses heavily on these two macronutrients to ensure optimal athletic performance.

Components of a Periodized Nutrition Plan

A periodized nutrition plan must meet three broad criteria: a caloric intake that supports general health and energetic requirements, satisfactory carbohydrate consumption, and adequate protein consumption.

Caloric Intake

Maintaining adequate energy availability (EA) is essential for optimal performance and to support optimal muscle protein synthesis. This is also one of the more critical areas for strength training because many athletes in this field compete within weight classes, which can lead many to try and dramatically reduce calories as a way to decrease mass.

Analyzing both fat-free mass (FFM) and energy expenditure from exercise can help to determine the ideal EA calculations.

Caloric intake should also reflect the athlete's goals, whether that be losing, gaining, or maintaining muscle mass.

$$EA = \frac{\text{Energy Intake} - \text{Exercise Energy Expenditure}}{\text{Fat Free Mass (kg)}}$$

Carbohydrates

While strength training does not deplete muscle glycogen to the same degree as endurance training, carbohydrates are still an important energy source and may even be preferred for strength and power athletes. In fact, low glycogen levels can result in increased fatigue during exercise[11] and decreased athletic performance.[14, 15]

Protein

Protein consumption is essential for power and strength athletes due to its role in supporting muscle growth and repair after training.[2, 5, 6]

Fats

Strength and power athletes may not typically use fat as fuel during competition, but it's still important to include in their diet. Dietary fat helps with hormone production and absorbing fat-soluble vitamins like A, D, E and K. Furthermore, n-6 (Linoleic acid) and n-3 (Linolenic acid) fatty acids are essential nutrients which your body needs to function. Without adequate fat in your diet, you might be more likely to suffer from a deficiency in these nutrients. Therefore, it is advised that fat intake should not fall below 20% of total caloric intake for prolonged periods of time and should likely stay within the AMDR range of 20-35% of total calorie intake.

Developing a Periodized Nutrition Plan

A periodized nutritional plan can serve as a way to optimize body composition and training results. However, its creation requires knowledge of the athlete's training program, goals, annual competitions, and off-season cycles.

While a periodized nutrition plan will be customized to the athlete and their specific training program and schedule, Mota et al.[1] were able to outline some general guidelines for specific training plans and goals.

For example, an athlete who is looking to increase body mass while maintaining their training volume should increase their calorie intake to increase body mass by 0.1-0.25% per week. Additionally, their carbohydrate consumption should be at 6-7 g·kg body mass^{-1} and their protein at 1.2-1.8 g·kg body mass^{-1}.

If the athlete wishes to increase their training volume while also increasing their body mass, their carbohydrate and protein consumption should stay the same, but they will need a larger calorie increase to reflect this increase in training volume.

General recommendations for calorie, carbohydrate, and protein intake vary based on body mass and training goals, and can be further refined based on the athlete themselves.

Evidence-based modifications for nutrition periodization in strength athletes

	Decreased body Mass	**Maintaining body Mass**	**Increasing body mass**
Decreased training load	Decreased calorie intake sufficient to lose (~0.25-0.75%) of body mass per week Minimum EA, 30 kcal x kg^{-1} FFM CHO, 4-5 g/kg body mass^{-1} PRO, 1.6-2.4 g/kg body mass^{-1}	Slight decrease in caloric intake to reflect decreased training load CHO, 4-7 g/kg body mass^{-1} PRO, 1.2-1.8 g/kg body mass^{-1}	Not recommended (Not ideal for skeletal muscle growth and/or increased risk of fat accumulation)
No change in training load	Decreased calorie intake sufficient to lose (~0.25-0.75%) of body mass per week Minimum EA, 30 kcal x kg^{-1} FFM CHO, 4-5 g/kg body mass^{-1} PRO, 1.6-2.4 g/kg body mass^{-1}	No change in calorie intake CHO, 4-7 g/kg body mass^{-1} PRO, 1.2-1.8 g/kg body mass^{-1}	Increased calorie intake to increase body mass 0.1-0.25% per week CHO, 6-7 g/kg body mass^{-1} PRO, 1.2-1.8 g/kg body mass^{-1}
Increased training load	Not recommended (increased risk of overtraining or injury)	Slight increase in caloric intake to reflect increase in training load CHO, 4-7 g/kg body mass^{-1} PRO, 1.2-1.8 g/kg body mass^{-1}	Increased calorie intake to increase body mass 0.1-0.25% per week CHO, 6-7 g/kg body mass^{-1} PRO, 1.2-1.8 g/kg body mass^{-1}

Assumes neutral caloric balance at a current level of training volume

CHO = carbohydrates ; EA = Energy Availability; FFM = fat-free mass; PRO = Protein

Mota, J. A., Nuckols, G., & Smith-Ryan, A. E. (2019). Nutritional periodization: Applications for the strength athlete. *Strength & Conditioning Journal*, *41*(5), 69–78. https://doi.org/10.1519/ssc.0000000000000488

Specific Events

In addition to the general body goals of increasing, decreasing, or maintaining body mass while increasing, decreasing, or maintaining training load, there are also suggestions specific to the events in the athlete's training and competition. As such, these events should also be considered when developing a nutritional periodization plan.

Competition is one such event that may require an alteration to nutritional needs. For example, those who complete in weight classes may utilize acute weight cutting to compete in a lower class. Yet another consideration is that those in strongman competitions may compete in multiple events in a day. These competition types and event frequencies must be taken into consideration to address increased EA demands and ensure carbohydrate supplementation that promotes the athlete's well-being and optimal performance. Because of this, competition days often benefit from increased carbohydrate intake.

Female Athletes Additional Considerations

Regarding nutritional needs, female athletes require additional considerations due to the hormone changes they experience through the menstrual cycle. Namely, these hormones impact their metabolic rate and total daily energy expenditure.

Because of these changes, it is often recommended for women to slightly increase their calorie intake during the luteal phase of their menstrual cycle, as this is when sleeping metabolic rate and total daily energy expenditure are higher.[16]

Menstrual cycle dysfunction can also occur with inadequate caloric intake,[17] so it is also important to account for caloric needs in the menstrual cycle.

Besides the menstrual cycle and the way it impacts the female body, women may also be less responsive to glycogen supercompensation methods. As such, they may need higher carbohydrate intakes when glycogen saturation is required.[18, 19]

Nutritional Periodization for Strength Athletes

Periodization for training has long been utilized to provide variety to a training program, strengthen all muscles, and ease recovery by varying the muscles trained. This component of training is essential for improving athletic performance, so it only makes sense that applying this same approach to nutrition, which provides the fuel for energy and muscle production, will also increase athletic performance.

Nutritional periodization helps to match dietary needs to the athlete's body composition, training load, and competition goals. Some key components are the total energy and macronutrient intake, specifically carbohydrates and protein. Varying the intake of these three categories can help the athlete complete their training more effectively, see better results, and reach their goals.

For more information, contact Dr. Brandon Welch,
Human Performance Specialist.
Email: info@pharmacyathlete.com
Phone: 239-662-5070

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PART 1

Applied Sports Nutrition for the High School Athlete

By Sean Casey, RD, CSCS

AUTHORS BIO:

Sean Casey RD CSCS is a registered dietitian, movement coach and member of the Evolve Wellness Science Team at Hometown Pharmacy of Wisconsin. He specializes in sports nutrition, nutraceuticals, and proactive care.

Quick Hit Summary

Science is great but without correct application the real-world effects of it can land with a dud. In Part I of this two-part article series, we look at how to blend science with the art of application as it relates to sports nutrition for the high school athlete. Specific focus is placed on establishing a daily meal plan.

Science vs. Applied Science

Science is impressive but what's even more awesome is applied science, especially for sport pharmacists and those that work in a pharmacy setting. As a registered dietitian who specializes in sports nutrition, there are many things I've learned over the years when it comes to getting the best results with athletes. One of the key things I've learned is that it's not my personal understanding of the "hard core science" that makes a difference, but rather the application of the science and getting student athletes to buy-in.

In this two-part article series, we'll discuss applied sports nutrition strategies when working with high school students. Part I will focus on getting athlete buy-in and daily nutrition whereas Part II will focus on peri-workout nutrition and supplements. With that being said, let's dive into Part I!

How do you get the WIIFM (What's In It For Me) with high school athletes?

Within a high school setting, it's important to get buy-in. What's the athlete's WIIFM? Why should they listen to you?

I always start by asking questions, "What do you want to learn about? What are your goals?" Based upon this, I address accordingly.

If the student athlete isn't sure where to begin or answers broadly, "I want to be the best possible athlete I can be," I focus on establishing why nutrition is important for sport.

In these situations, I establish the role of nutrition as it relates to the big picture of their athletic performance. Does the athlete know when his/her actual training "gains" happen as it relates to increasing fitness levels? Does this happen during the training hours or non-training hours? Don't assume that they know the answer to this question!

Often, I find that many high school students, especially younger ones, believe that physical training gains occur during the actual training/practice session. This provides a great opportunity to educate them on how their muscles break down and burn through energy supplies during a training session.

Most high school students are training approximately 1-3 hours a day. That means they have 21-24 hours to focus on recovery – and nutrition plays a big role in this recovery process. As I share with athletes, it's not how hard you train but rather how fast you can recover between training sessions that dictates both short and long-term athletic performance!

Building upon this, it's important to emphasize that sports nutrition is far more than just "game day" or "night before game day" nutrition. High school athletes and coaches tend to hyper focus on nutrition only 1-2 days per week vs. all 7 days.

For instance, if we look at varsity high school football, most athletes pay closer attention to what they eat the night before the

Angie Mackaman #63- 3rd base The Enforcers softball team

game (Thursday) as well as game day (Friday). However, if they're not eating and rehydrating well on the other days of the week, their ability to focus during practices/game film review on Saturday-Thursday is going to be compromised. In other words, they're missing out on the key opportunities to prepare for their next opponent!

How much time is spent on the basics of nutrition?

In my experience, when people hear "sports nutrition", they often focus on pre/post workout nutrition, game day nutrition and supplements. However, the actual "sports" aspect of sports nutrition is only about 25% of the picture; the remaining 75% is simply good, healthy nutrition regardless of if one participates in a sport or not.

Coincidentally, as I often point out to students, there are four syllables in the phrase "sports nutrition", 25% of which is "sports" with "nutrition" taking up the remaining 75% - funny how it works out like that!

Although exceptions exist, generally speaking, I keep this same 1:3 ratio of sport specific to general nutrition when talking to high school athletes. That being said, I present general nutrition through a sports focused lens with respect to food and energy intake.

How much should I eat for athletic performance?

Undereating, especially in high school female athletes, is something I see often. The ramifications of undereating are well established – poor physical performance, trouble concentrating/mood issues, increased risk of injury/illness and altered hormone levels.

Thus, it's important to teach athletes the importance of consuming enough food. But just how much food is enough?

To stay within energy balance much less add lean mass, depending on their sport and body size, high school boys may easily need > 3000-5000 kcal per day. In the case of females, this number may be >2300-3500 per day.

My goal is to have athletes eat as much nutrient dense foods as possible while maintaining a healthy body weight which maximizes their athletic performance. It's important to realize that a weight on the scale may not directly correlate with performance on the field or court. I place emphasis on the latter vs. hyper focusing on a scale weight. Emphasis on a scale weight can easily contribute to eating disorders in athletes.

Additionally, since people eat food (not numbers!), I center education on the amount of food eaten to hit these numbers – and it's A LOT!

For instance, to hit 3200 kcal, one needs to be eating approximately 11 six-inch grilled chicken subs from Subway or approximately 17 packs of Nature Valley Oats & Honey Granola bars.[1,2] Although I'd never encourage one to consume their food from one source, it can be eye opening to cite just how much one needs to eat in food quantities, to maintain energy balance.

So, what do I actually eat & drink?

Once athletes start to understand the need for eating enough food to stay in a healthy energy balance, the next question is, "So what do I actually eat?"

From a scientific standpoint, we all know what proteins, carbohydrates and fats along with micronutrients are essential for optimal sport performance. However, does the student athlete? More importantly, do they know healthy whole food sources of these nutrients?

When talking with high school students, I recommend giving them a list of healthy food options that are high in healthy proteins, carbohydrates and dietary fats. Additionally, I've found that referencing food portion relative to their hand works great. Specific reference points I find effective:

Palm = Serving of meat

Fist = Serving of fruits/vegetables/starches

Thumb = Serving of Fat

Surface area of palm = Serving of nuts, seeds

Looking at the macronutrients more in-depth, below are some effective touch points with respect to applied sport nutrition.

Protein

Many athletes may know that protein is important for muscle recovery. However, in the case of protein, I find various misconceptions exist with high school students, their parents and school administration. Common misconceptions I hear include "too much protein is hard on the kidneys" or in the case of females, "protein will cause me to look bulky and lose my feminine figure."

Additionally, I find some athletes are under the impression that protein should be their primary source of energy in order to maximize muscle. In this situation, more does not always equal "more" when it comes to protein. Generally speaking, I aim for 0.7g/lb. of goal body weight when making recommendations to high school athletes.[3]

With respect to serving sizes, I'm aiming for approximately 20-35g protein per meal. To help students understand what this may look like, I like to reference the palm of their hand as a 20g serving of meat or 1-2 cups of dried beans/peas.

Generally speaking, I aim for approximately 20-35g of protein every 3-4 hours. Easy "take to school" protein foods for athletes to munch on during the day include yogurt, beef sticks/jerky, smoothies, string cheese, protein bars, precooked beans/lentils. These can be stored in a small cooler that they can keep in their locker and grab as needed.

Carbohydrates

Although some high school athletes may know that carbohydrates are their primary source of energy during high intensity activity, many may not. In practice, I've actually found many high school athletes to undereat on carbohydrates simply because they've heard that "carbs cause one to gain fat." It's essential to address this issue and explain how carbohydrates are absolutely essential.

With respect to serving size, I inform athletes that their fist is a good reference point with respect to a serving of fruits, starchy vegetables or whole grain.

On a fruit and vegetable note, every high school student has been hearing since first grade the importance of eating fruits/veggies. Despite knowing this, many fail to consume a minimum of 5-6 servings per day, much less the optimal amount of equal to or greater than 7-8 servings/day, ideally including 4 different colors (i.e. red – apples, blue – blueberries, green – broccoli, orange – carrots).

Thus, it's important to present it in a way they can relate to. A succession of three questions can be extremely effective:

"Have you ever gotten sick during the sport season?"

"How well did you play while sick? Was it fun?"

"Did you know that consuming more than 6-8 servings of fruits and vegetables per day, spread across 4 different colors, may reduce your risk of getting sick during the season?"

This approach can be an effective way to help student athletes draw a direct connection between fruits, vegetables, the antioxidants within them and their performance on the athletic field.

Along with emphasizing these key points, I'll also hammer in the point that fruits and vegetables greatly speed up recovery between workouts due to antioxidants and other healthy nutrients within them.

For those who are picky eaters, I'll encourage them to add dark leafy greens like spinach into their protein smoothies and/or use dips like peanut butter, humus or ranch dip to encourage fruit and vegetable intake.

Fats

Students may know that dietary fat is a source of energy. What's lesser known is that fats are critical for the absorption of many antioxidants as well as support uptake of fat-soluble vitamins like vitamin D.[4-6] Similar to carbohydrates, I find that many athletes avoid dietary fat simply because they are concerned that eating it leads to increasing their own body fat levels. This is a great opportunity to re-emphasize the importance of energy balance.

Healthy dietary fats that I put high emphasis on are nuts, seeds, avocados, olive oils, peanut butter, eggs and omega 3 sources like fatty fish.

"food is medicine" snacks - Adult PB&J

Apple substituted for bread & semi-thawed berries for jam - all held together with natural peanut butter!

Filled with immune supporting antioxidants (antioxidants = nature's natural anti-inflammatories), GI friendly fiber, healthy fats & TASTE!

If the athlete doesn't have any dairy intolerances or allergies, hard and soft cheese along with whole milk can be an option. As it relates to serving size, I use a thumb as the reference point for oils and butters along with a palmful of nuts/seeds.

As aforementioned especially those with high energy intake needs, I've found peanut butter to work great when added to foods. One particular combo that has resonated with high school athletes in my experience is adding peanut butter to an apple which has been cut in half.

One can take the apple combo to the 'next level' by putting semi thawed berries on top of the peanut butter. It turns into what I like to refer to as an open faced adult PB&J sandwich where the apple is used in place of bread and semi thawed berries are used in place of jelly.

Fluid intake

Although not a macronutrient per say, fluid intake may very well be the most underappreciated item consumed during the day!

It doesn't take much dehydration to see physical and mental performance decline. I encourage student athletes to carry a water bottle around and sip throughout the day. Although general rules of thumb like "Drink half your body weight in ounces during the day" can be effective, there are shortcomings to them.

Depending upon temperature and humidity levels outside along with how physically active someone is, an individual's fluid intake levels can vary significantly. For this reason, I encourage athletes to use a more dynamic method to gauge fluid intake requirements. I recommend consuming enough fluid during the day such that they have to go to the bathroom approximately every 1.5-2 hours, during which their urine color should be relatively clear.

If participating in hot weather I'll encourage athletes to weigh themselves before and after practice, with a goal of consuming 1 pint of fluid for every pound lost during practice.

Water, electrolyte drinks and assuming they're not dairy intolerant, milk, are my preferred beverages. I encourage student athletes to be mindful of fruit juice as they tend to be sugar bombs and discourage the use of soda.

What does a healthy meal plate look like and how often should I eat?

Once understanding healthy food sources, the next question is, "How do we put these together into a daily plan?"

There are many ways to tackle this issue, however the key is making sure they are getting a variety of minimally processed foods rich in micronutrients. Each meal should include healthy proteins, fats and carbohydrates. One resource that can be a great visual for athletes is giving them a copy of the Athletes Plate®, which is a free resource. It nicely lays out what a meal plate should look like depending upon intensity of training.

As it relates to timing throughout the day, I encourage athletes to eat every three to four hours. This is especially critical if training twice per day or have high energy requirements.

As it relates to timing of food intake, one important point of emphasis is making sure that they're getting in an afternoon snack between their lunch and start of their practice. Often, I've worked with high school athletes who eat lunch at 11:30 am, have practice at 4:00 pm and by the time they shower up, drive home and have dinner, it's almost 7:00 pm; a time span of 7.5 hours without eating!

I encourage student athletes to bring snacks which can be kept in their lockers and eaten around 2:00 pm. Examples of this would be a protein bar, PB&J sandwich, trail mix, fruit, yogurt/smoothie, jerky and similar type of items.

Wrapping Things Up

As discussed in this article, science is great, but it's the application of science that makes the difference when it comes to maximizing performance for the high school athlete via sports nutrition intervention.

The application of sport nutrition strategies should focus on educational strategies that allow nutrition to become "easy" and "doable" for the athlete.

In doing so, sport pharmacists, dietitians and other qualified professionals can establish pharmacies as the "go to" place for sports nutrition!

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Enforcers 14U Grey Wins USSSA 'c' Eastern National Championship

By Dr. Kourtney Chichilitti, PharmD.,
Certified Integrative Nutrition Coach,
Certified Functional Medicine Specialist

The Enforcers 14U Grey Softball team is made up of twelve girls. The unique factor of this team of National Champs is that it was formed of all local girls, living in the same suburban area in Pennsylvania. Usually teams of this stature have players selected from different teams who are at the top of their game in this competitive atmosphere. Their season started back in August, 2021 and they wrapped up their season this July at the USSSA Eastern Nationals in Loudoun County, Virginia. Through hard work and dedication, this group of athletes achieved the most amazing accomplishments in the past year.

As the season started, players began attending three practices a week. In addition, the pitchers and the catchers attended a fourth day of training each week. Practices focused on overall knowledge of the game, as well as agility and speed training, batting practices, team-building activities and how to handle positive attitudes during times of failure.

This year the players also participated and volunteered their time to help a local recreational softball program by helping younger softball athletes with their fundamental skills when it comes to the game through winter and summer workout clinics.

During the course of the season this group of girls played 62 games and ended their season winning the USSSA Eastern National Champion Game in a come behind 7 to 6 win.

Throughout this season this young group of athletes have pushed themselves physically and mentally which has made them each a stronger player and person on and off the field.

Some fun things that I learned about the girls…

I asked them what gets them amped up before a game…Hailey Cabot said, "I talk to my teammates and try to give out positive vibes. We also listen to music to pump us up!" Gianna Howard plays hip hop music and tells herself, "I got this." Averi Sullivan gets amped up by the thought of winning…and chickens!! This created universal laughter in the group! If the team had a mascot, it would be a chicken! The girls love this idea!! They all agreed it is a team effort to get pumped up by hyping each other up together. It was apparent speaking to these girls that they are the true definition of a team, showing each other support and friendship both on and off of the field.

The girls are so passionate about the love of the game. They keep themself conditioned year round. Jayda Sassaman does gym training off season, using dumbbells, focusing on the speed ladder, and sets aside specific days for upper body, lower body and ab workouts. Julie and Angie Mackaman are sisters who do fielding and batting all year round. Danica Borzillo

plays volleyball off season. Teghann Bowman practices catching with her dad, she makes sure she is eating healthy, making good nutrition choices to stay fit, and loves to hit the batting cages to stay on her game! All of the girls are doing off season training for the love and passion of the sport. They are all so disciplined and train three to four days a week.

We talked about preparing their bodies for their games so that they can achieve maximum performance, keeping their bodies safe and healthy and focusing on self-care after the games as well to keep themselves conditioned. They all agreed that hydration, especially in the Summer, is crucial to their performance and staying healthy. Teghann Bowman stretches her arms and legs as the Catcher to avoid cramping both before and after games and practices, and ices her arms and knees when she needs it, as well as incorporating massage therapy into her regimen. Hailey Cabot has a stretch routine both before and after games and practices, and she focuses on eating cleaner, adding some extra healthy snacks on game days, and making sure to stay hydrated. Gianna Howard makes sure she is getting enough protein-rich foods and staying hydrated on game days. All of the girls are tuned in to this selfcare and make sure they are taking care of their bodies.

The best was hearing all of the girls' feelings and emotions as they got that last strikeout pitched by Lexi DiBricida that won them the championship. The way these girls spoke, not only about winning, but about their experiences throughout the season, and really working together as a team was phenomenal! To see how excited and proud of each other these amazing athletes are for their teammates, telling me they were jumping for joy, feeling so emotional, bursting into tears, and just feeling absolutely "surreal" to each one of these girls. There is no doubt that these girls will achieve much success in life with anything that they set their minds and heart to, and that they have created a life-long bond as teammates and friends. What a special team of young ladies! Congratulations, Enforcers!

Meet the Team:
Lia DiLorenzo #99 -3rd base, catcher
Teghann Bowman# 7-catcher
Hailey Cabot #11- pitcher, 1st base, outfield
Tori Cavanaugh#13- pitcher, outfield
Julie Mackaman#24- 2nd base
Averi Sullivan #6- shortstop
Angie Mackaman#63- 3rd base
Lexi DiBricida#20- pitcher, 1st base
Julia Edmond#29- outfield
Gianna Howard#4- center field
Jayda Sassaman#21- left field
Danica Borzillo #18- outfield

The Coaches:
Tony Cabot- Head Coach
Kevin DiBricida- Assistant Coach
Scott Borzillo- Assistant Coach
Matt Janis- Assistant Coach

Hydration for Athletes

By Melissa De Brito, PharmD, AFMC

AUTHOR BIO:

Dr. Melissa De Brito, is a pharmacist, functional medicine health consultant, and health coach. Dr. Melissa received her Doctor of Pharmacy degree from the University of Tennessee College of Pharmacy in 2011. She has completed pharmacy residency training and has worked as a clinical pharmacist in the hospital setting. Dr. Melissa has additional certification training in functional medicine, culinary nutrition, group fitness, and restorative wellness with ongoing lifelong education in these areas as well. She has turned her passion for functional and lifestyle medicine to educating and empowering others to take control of their health by unlocking the body's healing potential and addressing the root cause of their underlying health challenges. Melissa also knows what it's like to be a high-level athlete, having played D1 soccer and running in half marathons. She now coaches soccer in her area as well.

Euhydration, Dehydration and Hydration

Maintaining euhydration, the state where the body has an adequate volume of water to meet physiological demands and to stay within its optimal homeostatic range, is essential in functioning properly. The human body is comprised of approximately 50-70% water. Almost 2/3 of total body water is found within the intracellular fluid while approximately 1/3 is within the extracellular fluid (ECF). Water is one of the most essential nutrients of life. It works as a medium for biochemical reactions and processes, transports nutrients, oxygen, and waste material, assists in thermoregulation, and is critical for cellular exchanges.

Dehydration, the process of incurring a fluid deficit by losing body water and moving from a state of euhydration to hypohydration, can ensue when an athlete's sweat loss exceeds fluid intake. Dehydration of 2-3% or more of body weight can impair coordination, cognitive tasks, and physiologic function while increasing risk of heat-related illness. Unfortunately, this level of dehydration is common and can occur within one hour of exercise, or more rapidly if the athlete is dehydrated prior to the start of a training session. Staying hydrated is important for humans at all activity levels, but it is especially important for athletes during vigorous exercise. Hydration is the process of adding adequate amounts of fluid to bodily tissues, and optimal hydration requires a balance of fluids and electrolytes. Maintaining hydration in the athlete is dependent on many factors, and it must also be combined with avoiding excessive fluid intake as this can result in overhydration potentially leading to hyponatremia.

Factors Contributing to Hydration

Fluid intake recommendations for athletes have evolved, and the current consensus recommends good hydration practices include beginning training in a state of euhydration, preventing excessive hypohydration while training, and replacing remaining fluid losses following training and prior to the next training session. It is acknowledged that fluid needs rely on many factors and should be individualized to the athlete. These factors include environmental conditions such as ambient temperature, heat index, humidity, clothing and equipment, altitude, and air flow; intrinsic factors such as sex-specific differences, age, body size, and sweat rate; and sport-specific factors. Furthermore, biochemical changes occur during exercise that can alter thirst sensation, so drinking to thirst only is not always optimal. Consideration of these factors can be used as a general guideline to help strategize a hydration plan for the athlete with practical strategies to assess and tailor hydration.

Assess Hydration Status

Hydration status should be assessed and monitored, and there are a variety of ways to monitor the body's hydration status with varying degrees of accuracy, difficulty, expense, and practicality. The two most precise methods are also the most impractical, expensive, and difficult to obtain for day-to-day use by athletes and are best suited for research studies. One of these methods includes a measurement of total body water and plasma osmolality from a radioactive isotope dilution using deuterium oxide, and the second method is through a

blood sample that measures plasma osmolality, the number of particles of solute per liter of plasma. The plasma osmolality measurement associated with euhydration is between 275 and 295 milliosmoles per kilogram, and dehydration is a plasma osmolality of >300 milliosmoles per kilogram.

Daily monitoring of hydration status for the athlete should be practical, easy to perform and understand, which is why a practical means of measuring dehydration in the athlete is using a combination of first morning urine color, body weight, and thirst. In the morning, the athlete can evaluate whether body weight is noticeably lower than the previous morning (ideally maintaining day-to-day body weight within 1%), the darkness or lightness of urine color with darkened color suggesting hypohydration, and if there is thirst, craving of fluids or dry mouth. The presence of two of these conditions suggests hypohydration is likely present, and the presence of all three conditions suggests it is very likely that hypohydration is present. Limitations of this practical hydration assessment method include that urine color can be affected by diet, dietary supplements, and medications, and checking body weight every day might be detrimental if an athlete struggles with an eating disorder or anxiety related to degree of body fatness.

Hydration strategies can be pursued based on the above-mentioned factors and determinants of hydration status. Evaluation questions to consider when formulating a hydration plan for the athlete include:

1) Is the athlete euhydrated?
2) What are the athlete's goals prior to exercise?
3) What are the athlete's goals during exercise?
4) What are the athlete's goals after exercise?

Additional considerations for developing a hydration plan include increasing the availability of fluids, establishing breaks based upon environmental conditions, making fluid readily available for athletes, maximizing opportunities for rehydration, identifying athletes with high sweat rates or other factors that limit optimal hydration, identifying athletes who have altered thirst drive compared to their fluid loss, counseling and monitoring athletes on proper hydration, counseling athletes on the health and performance risks of dehydration as well as overhydration.

Indexed of Hydration Status			
Condition	% Body weight change	Urine Color	Urine Specific Gravity (USG)
Well hydrated	+1 to -1	1 or 2	<1.010
Minimal Dehydration	-1 to -3	3 or 4	1.010 to 1.020
Significant Dehydration	-3 to -5	5 or 6	1.021 to 1.030
Serious Dehydration	> 5	> 6	> 1.030

Composition of Hydration Mixes for Athletes

The composition of the fluid that an athlete consumes to maintain hydration is important. Approximately 95% of all fluid absorption occurs in the small intestines, and it works to keep water and sodium in balance so that blood plasma remains within the normal osmolality of 275 and 295 milliosmoles per kilogram. Ideally, the fluid being consumed should be a lower osmolality than the blood so that the intestinal walls allow it to pass into the bloodstream. If the fluid consumed is overly concentrated compared to the blood plasma osmolality, then the intestinal cells will pull water from the vascular spaces of the body to dilute the higher osmolality within the intestines. This potentially adds to dehydration and can trigger gastrointestinal distress from excess fluid sitting in the intestines due to an osmotic effect.

Optimal hydration requires fluid that contains co-transporters working molecularly to carry fluid across the intestinal cells and into the vascular water spaces of the body. Sodium works to maintain fluid in the plasma for evaporative cooling and sweating, enhances fluid retention, increases the body's natural thirst sensation, and enhances glucose and water absorption from the intestinal walls and into the bloodstream for cellular hydration. Glucose and sodium work together with the transport mechanisms in the intestines, and without a small amount of glucose, the constant flow of sodium and water into the bloodstream can slow down. This is also why consistently drinking plain water is not

satisfactory for optimal hydration, because plain water does not contain the drivers to get the fluid into the cells of the vascular spaces. Plain water can also signal a volume response in which the body urinates and flushes out more water and electrolytes than what is being absorbed. The inclusion of sodium in a hydration sports drink during training is paramount, while the inclusion of potassium, magnesium, and calcium is not as critical if the athlete is consuming these electrolytes through nutrient-dense foods in their diet. Sodium-based electrolyte drinks are ideal, and addition of potassium and magnesium in a hydration sports drink can be a personal preference or included when the exercise intensity is high, or the duration of exercise is prolonged.

Historically, many of the available sports drinks have contained a 5 to 8% carbohydrate solution. This can be too concentrated for some athletes causing a water influx into the intestines, as the osmolality of a higher carbohydrate solution can be higher than normal blood osmolality. Certainly, concentrations greater than 8% slow the rate of fluid absorption and coupled with intense exercise will have a decreased rate of gastric emptying. A fluid solution of glucose and/or sucrose at a 1.5 to 4% carbohydrate concentration combined with sodium works with the rules of osmolality allowing for faster emptying out of the stomach and greater fluid absorption from the small intestines into the cells. The optimal hydration strategy for the athlete is to show up hydrated prior to training by pre-hydrating, take in enough sodium to work with the physiological demands under exercise stress conditions, and then appropriately rehydrate after training.

An example of the fluid composition to recommend the athlete consume could be a homemade functional hydration mix containing per 16 ounces of filtered water 1 teaspoon of pure maple syrup with 1/16th to 1/8th of a teaspoon of quality salt. If a pre-mixed product is preferred, it is important to consider the goals of the athlete, and if they are targeting hydration prior to training, during training, or following training, as well as the intensity and duration of exercise. Many hydration drink mixes are available on the market that consider electrolyte ratio (sodium, potassium, magnesium, calcium) and carbohydrate content. Some commercial sports hydration mixes market for hyperhydration (indicating a pre-training mix) and sport and endurance (indicating use for during training). Other characteristics to consider when choosing a hydration product are products that contain no coloring, artificial ingredients, or sugar substitutes indicating a product with clean ingredients. Sugar substitutes such as sorbitol, mannitol, and xylitol are sometimes used in "lighter" or low-calorie sports beverages, but it is important to understand that some of these sugar substitutes cause gastrointestinal distress to the athlete and as mentioned, a small amount of glucose is ideal to work with sodium to shepherd fluid across the intestinal wall and into the cells. Some natural sweeteners such as stevia can be well tolerated by some athletes but can cause gastrointestinal issues for others.

Dr. Melissa De Brito competing in a soccer tournament

Fluid Intake Prior to Training and Performance

Fluid intake before training and performance depends on the athlete's goals and tolerances. Typically, the goal is to be fully hydrated prior to training and, if not fully hydrated, rehydrating to the greatest extent possible while avoiding gastrointestinal upset. Many athletes become chronically dehydrated when they perform repeated exercise trainings either on the same day or on consecutive days. A hypohydrated athlete will have compromised physiologic mechanisms when they begin to exercise. For endurance athletes, one of the single most effective strategies is pre-hydrating starting the one to two days before endurance training or competition with sodium-rich fluids such as organic bone broth or a sports nutrition sodium-based hyperhydration drink mix. Throughout the day on the day of training, eating watery fruits and vegetables, drinking herbal tea, mineralized water, or low carbohydrate electrolyte drinks can help athletes stay hydrated. One study by Sawka et al. recommends pre-training fluid consumption begins at least 4 hours prior to training, and if the athlete has already rehydrated from the previous day's exercise, then the fluid intake should be slow. The amount of fluid intake will depend on the individual, but a general rule of thumb is to have the athlete consume ~5 to 7 mL/kg at least 4 hours prior to training. For example, a 50 kg athlete could start with a goal of consuming 250-350 mL of fluid before exercise begins. Additionally, there are studies showing that fluid consumption in the 90 to 105 minutes leading up to a high intensity and longer duration training session with a high-sodium solution can reduce feelings of fatigue, reduce the rise in core body temperature, reduce average heart rate, and increase exercise duration. These studies looked at adding high amounts of sodium of 2.3 to 4.3 grams in 22 to 33.8 ounces of water consumed prior to exercise, but further research needs to be performed to evaluate athletic performance and safety with this amount of additional sodium.

Fluid Intake During Training and Performance

During training, many athletes benefit from fluid consumption during exercise, and typical goals include maintaining power to the end of the session, preventing excess dehydration (>2% body water loss) while acclimating to mild dehydration, avoiding overconsumption of water and hyponatremia, replacing sodium losses only to meet the physiologic demands under exercise conditions, consuming some glucose, and avoiding gastrointestinal upset. Appropriate hydration during training sessions will positively influence cardiovascular function, thermoregulation, muscle function, fluid volume status, and exercise performance. One of the reasons why hypohydration is difficult to completely avoid while exercising is because of the physiological inability to empty water from the stomach and absorb it into the blood as fast as it is being lost. While the maximum rate of gastric emptying and fluid uptake in adults is approximately 1 liter per hour, water may be lost in sweat at rates twice that amount when heavy sweating takes place. However, given the small contribution of water from metabolic processes, athletes may not need to exactly match fluid intake with sweat loss to maintain water balance.

In the past, recommended guidelines for fluid replacement during exercise was to consume approximately 150 to 350 mL of fluid at 15- to 20-minute intervals beginning at the onset of exercise. However, current guidelines have evolved and organizations such as The American College of Sports Medicine (ACSM) now recommend a customized plan that considers the factors discussed earlier. ACSM makes a generalized recommendation of consuming 0.4 to 0.8 liter of fluid per hour as a starting point for endurance athletes during exercise, although some athletes may need less or more. For lower intensity training or sessions shorter than 90 minutes, a functional hydration drink mix that contains water, a low-carbohydrate glucose and/or sucrose solution, and quality salt might be sufficient. An example of this type of functional hydration mix for lower intensity or shorter duration training would be adding 1/16th of a teaspoon of quality salt and 1 teaspoon of pure maple syrup to 16 ounces of filtered water, yielding approximately 145 mg of sodium and 4 grams of carbohydrate, which is ~1.5% solution, and on hotter days adding 1/8th of a teaspoon of quality salt can be added per 16 ounces. Training sessions lasting longer than 90 minutes or in the heat might require a hydration beverage that contains 3-6% carbohydrate from glucose and/or sucrose, 150 to 180 mg sodium, and 50 to 100 mg potassium per 8 ounces of water, although there are some studies that reference carbohydrate solution concentrations up to 8% do not adversely affect the rate of fluid absorption.

Fluid Intake After Training and Performance

Replenishment after training and performance should involve rehydrating and restoring lost body water, replacing sodium and other

electrolytes lost, consuming adequate protein to build and repair muscles, consuming enough carbohydrate to restore muscle glycogen stores that aid in recovery, and avoiding gastrointestinal upset. Slowly rehydrating over the course of 2 to 3 hours is best to avoid the pressure response of flushing out more water and electrolytes than the athlete can absorb. A few options for rehydration include a protein and nutrient-dense carbohydrate smoothie or through whole foods such as watery fruits and vegetables, as well as more of a functional hydration mix containing sodium, other electrolytes (potassium, magnesium, calcium), and a low amount of carbohydrates.

Risk of Hyponatremia

Hyponatremia, although a rare occurrence in shorter athletic events, is a serious medical risk that may occur in endurance athletes who have prolonged exercise extending beyond 2 or 3 hours. Hyponatremia occurs when the plasma sodium concentration falls below 135 mmol/L, and exercise-associated hyponatremia is often characterized by a rapid drop to 130 mmol/L or below. Because of the importance of sodium in maintaining osmotic fluid balance between water compartments, low sodium concentrations in the ECF stimulate the movement of water via osmosis from the plasma ECF into the intracellular space causing the cells to swell. When nerve cells swell too much they begin to malfunction resulting in dizziness, confusion, seizure, coma, and possibly death. To prevent hyponatremia in the athlete, it is important to replace sodium and prevent fluid overload or overdrinking. Hydrating excessively with plain water or low-solute beverages can make the athlete susceptible to hyponatremia. It has been recommended that a hydration beverage contain approximately 500 to 700 mg of sodium per liter of fluid and that fluid intake does not exceed sweat losses to prevent exercise-associated hyponatremia.

Hydration Strategy Testing

A practical solution for determining if an athlete's current hydration plan is maintaining hydration is to test his or her current hydration strategy. Hydration status can be assessed by measuring body weight before and after exercise training sessions to assess approximately how much fluid was lost, along with monitoring urine color, urine specific gravity (USG), or urine volume. Using urinalysis strips with specific gravity can help determine if the current hydration strategy is working in the athlete's favor. A USG reading of less than 1.010 reflects a well-hydrated status, while a reading of more than 1.020 indicates dehydration. Using this strategy, the athlete would first test his or her current baseline hydration strategy and a specific exercise session. Measure body weight and urine specific gravity before and after the specific exercise session. If the exercise session is longer than 2 hours, then consider also testing the USG in the middle of the session. Assess if hydration was maintained with the current hydration strategy considering before, during, and after hydration. One week later, add a functional hydration drink using electrolyte and carbohydrate ratios that the athlete desires to test (e.g., higher electrolyte and lower carbohydrate solution). Then, perform the same testing of body weight and USG before and after the same type of exercise session, ideally the same time and day of the week, if possible. Compare the USG from baseline and the follow up test one week later. The athlete can then reevaluate regularly to determine if any changes need to be made to the hydration strategy.

Hydration status can be assessed by measuring body weight before and after exercise training sessions to assess approximately how much fluid was lost, along with monitoring urine color, urine specific gravity (USG), or urine volume.

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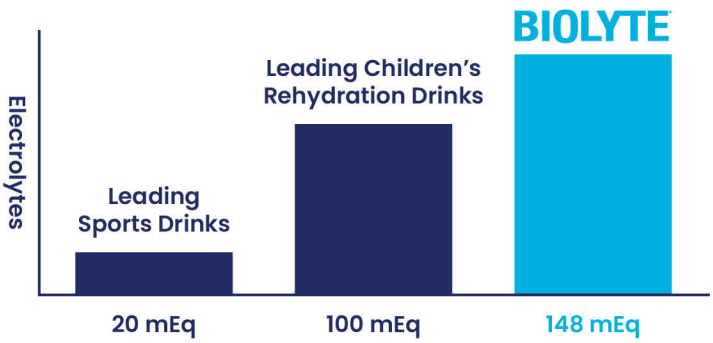

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Women's Sports Nutrition

Relative Energy Deficiency in Sport (RED-S)

By Dr. Jessica Beal-Stahl, Pharm.D.

AUTHOR BIO:

Jessica Beal-Stahl, PharmD, is the founder of The Athlete's Pharmacist company, tying her passions for athletics and pharmacy together where she works privately with clients to improve their performance in sport and life. She received her Doctorate of Pharmacy from Mercer University in 2009 and has been practicing as a Director of Clinical Services at Hobbs Pharmacy in Merritt Island, Florida, since graduation. Jessica also knows what it's like to be a high-level athlete, having played D1 volleyball, medaled internationally in Olympic weightlifting, and set at 41 years old a world record in Olympic Weighting for snatch in her age/weight class. She holds additional certifications in Integrative Medicine, Nutrigenomics, Olympic Weighflitng Coaching, and Sports Nutrition.

Energy availability is the amount of dietary energy available after the calories used during exercise are subtracted from the cost of exercise. Energy status and healthy body weight are critical for athlete health.

Athletes are often unaware of their caloric needs compared to non-athletes their age and have a 20% higher prevalence of disordered eating verse non-athletes.[1] Athletes commonly use dieting strategies for weight loss purposes to increase athletic performance believing "lighter is faster." A study presented showed 82% of middle school female athletes perceived "being thinner improved performance." [2]

Many athletes struggle to balance high pressure of sport with cultural and social pressures. Add pressures to conform to a perceived ideal body image; it can be like walking an impossible tight rope. I was one of those athletes. I'd love to say my story is unique, but it's not true.

In 1992, Female Athlete Triad was defined as a disorder characterized by relative dysfunction in energy availability (with or without disordered eating), menstrual function, and bone mineral density.[3]

In 2014, International Olympic Committee updated the term Female Athlete Triad to Relative Energy Deficiency Syndrome (RED-S) emphasizing the condition affects all athletes and redirecting the focus to energy intake. RED-S was defined as "impaired physiological function caused by relative energy deficiency, and includes, but is not limited to, impairment of metabolic rate, menstrual function, bone health, immunity, protein synthesis, and cardiovascular health." [4]

RED-S affects the whole body manifesting physically and psychologically. Athletes affected by RED-S have shared their stories about consequences such as osteoporosis and mental disorders and devastating impact on their quality of life and performance.

Subtle symptoms, which often are overlooked, may present in different forms such as poor sleep, constant fatigue, dysfunctional relationship with food, late/absent periods, increased illnesses, anxiety, mood changes, and changes in performance. Even athletes without disordered eating are at risk, high training load and unintentionally inadequate fueling or lack of recovery can contribute to RED-S in these athletes.

The initial weight loss might seem beneficial for some athletes, it's a short-term result. Continued energy deficiency limits the body's systems to function leading to a wide range of adverse effects on all body systems and seriously compromising long term health and performance. Research demonstrated both acute and long-term impacts including:

- Female athletes can experience amenorrhea leading to decreased estrogen causing weakened bones, increasing risk for injuries such as stress fractures. Treatment with oral contraceptives to address symptoms masks menstrual disturbances without providing bone protection.[5]
- Bone mass peaks in mid-20s; RED-S interferes with the peaking of bone mineral density. If not reached, there is no way to recapture bone which may lead to osteoporosis later.
- RED-S may predispose athletes to cardiovascular disease, impaired vascular function, and unfavorable lipid profiles.
- Energy reduction suppresses the immune system, decreases protein synthesis, increases risks of illness, and slows healing from injuries.
- Negative athletic performance, including endurance, response to training, recovery, coordination, muscle strength, glycogen storage, and cognitive function.
- Many athletes experience mood changes, such as irritability, anxiety, and depression.
- Younger athletes are most impacted by the non-reversible and long-term consequences, including decreased growth and hindered sexual development.[7]

Dr. Jessica Beal-Stahl competing in her weightlifting competition

The danger of RED-S lies not in its symptoms, but in our failure to recognize them *as* symptoms. Only 24% of coaches reported "having heard of the triad," and 14% could correctly name all components. While only 37% of healthcare professionals and 12% of athletes have heard of RED-S.[9] Yet 1/3 of athletes have reported missing 3 consecutive menstrual cycles, and 1/3 reported a history of stress fractures or shin splints.[8]

Weight status is not a definitive evaluation of athlete health. Athletes may be in a calorie deficit despite having a stable body weight due to reduced metabolic rate. RED-S can occur in athletes of any sport, age, body size, socioeconomic status, and athletic ability.

Interventions can have pharmacological and non-pharmacological components; non-pharmacological methods should be the initial course of action. Proper nutrition is the most effective approach to reducing the health consequences of RED-S. The quantity of macronutrients an athlete must obtain will depend on factors such as gender, age, body mass, and level of training activities. Proper amounts of micronutrients must also be obtained especially, calcium, phosphorus, iron, and Vitamin D.

RED-S is a sensitive topic and needs to be approached with care. When working with an athlete, you are challenging ideas ingrained in their mind and behaviors they taught themselves to be "wrong." Athletes will need a recovery plan emphasizing a team approach with physicians, dieticians, mental health practitioners, parents, and coaches all involved.

Encouraging athletes to seek help pays off BIG TIME in the long run for their health**.** I can say that thoughtfully from my personal experience. We need to break the taboos of societal norms that dieting/weight-loss increase athletic performance. Open conversations with athletes, parents, and coaches to educate them on the importance of proper caloric and macronutrient intake for sports is imperative for building a healthier generation of athletes.

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Nutrition in Female Soccer Players

A Guide for Healthcare Professionals

By Dr. Fay Fieruzeh Ansary, PharmD.

AUTHOR BIO:

Dr. Fay Fieruzeh Ansary is an Oncology Association Management Fellow at NCODA and an Assistant Women's Soccer Coach at Cazenovia College. She received her PharmD degree from the Bill Gatton College of Pharmacy at East Tennessee State University in May 2022 and is now using her passion for helping others to help cancer patients in her post graduate fellowship with NCODA. She specializes in student-centered initiatives and is a former DIII athlete at the Pennsylvania State University-Harrisburg where she competed as a two-sport athlete in women's soccer and tennis. Fay is tying her experiences of being a pharmacist, former athlete, and coach to teach others on ways to be healthy and happy.

Among the various sports that are available to play in the world, soccer is considered one of the most popular that women partake in. In soccer, nutrition is an essential part of a female players' health. However, there is little information regarding the proper nutrition that female players need so that healthcare providers can properly guide them. Therefore, this article aims to provide a guide to help healthcare providers with the tools to help this population of patients.

Each sport has different energy demands. In order how to determine energy needs for athletes, it should not only be based on basic metabolic rate and diet, but on the individual physical activity needs of the player.[1] With women, their energy needs may be lower because of their lower body weight and less intense training.[3] There have been numerous studies that have attempted to estimate the energy needs of female soccer players. Martin et al showed that energy expenditure was at a level of 2154 +/- 596 kcal/day.[12] However, Fogelhom et al showed levels at 2249 +/- 215 kcal/day.[5]

Since there are a wide range of values that have been shown, it is difficult to determine a set value for energy since it is dependent on individual players. However, there are tools that healthcare professionals can use to determine the total energy expenditure (TEE) in female soccer players. TEE can be divided into basal metabolic rate (BMR), diet-induced thermogenesis (DIT), and activity energy expenditure (AEE).[7,8] Calorimetric methods such as doubly labelled water (DLW) are shown to be one of the most accurate methods to measure TEE. DLW is a water that consist of two stable isotopes of deuterium (2H) and oxygen (18O).[16,14] When these two isotopes are consumed, their removals are different. Deuterium will be excreted as only water, while oxygen is excreted as both water and CO2.[16,14] Calorimetric can also be divided into direct and indirect methods. Direct calorimetric (DC) methods measure the rate of heat loss from the athlete's body using a sealed calorimetric chamber.[7,13,10,9] Indirect calorimetric (IC) methods measure respiratory gases using devices such as Douglas bags, ventilator hoods, and face masks under specific conditions.[7,13,10,9] With that being said, IC is much more accessible, practical, safe, noninvasive, and portable than DC making them seen and used more in the clinical practices.[7,13,10,9]

Even though the above methods have the highest accuracy in determining energy requirements, since they have a disadvantage of high cost, many use prediction equations (PE) to determine TEE. PE is readily available and simple to use to determine BMR for each individual. They use components such as body mass, height, gender, age, and lean body mass (LBM).[4] In order to obtain TEE, the BMR is multiplied by the factor of physical activity level (PAL).[4] However, even with its advantages, PE has a tendency to overestimate BMR and TEE as well as not accounting for ethnic variability, climatic conditions, or nutritional status.[11]

With all that has been said above, energy goals should be estimated individually for each player. Energy goals should be estimated using methods with the highest accuracy, and energy intake should be aligned with macro and micro-nutrients in the diet that is not lower than 30 kcal/kg fat free mass/day (for intake) along with exercise intensity at each training session.[4]

Macronutrients such as carbohydrates, proteins, and fats play very specific role in how an athlete can be at the max of their fitness and how successful than can be in sports competitions. For female soccer players, Dobrowolski et al recommend the following in the table below:[4]

Table 1

Recommendations for macronutrient intake for female soccer players.

Macronutrient	General	Before Training	During Training	After Training
Carbohydrates	• 5–7 g CHO/kg body mass/day with low to moderate intensity training program. • 7–12 g CHO/kg body mass/day with high intensity training program or match preparation.	• 1–4 g CHO/kg body mass for 1–4 h before training • 10–12 g CHO/kg body mass/day for period of 36–48 h before major competition.	• 30 g CHO/h for training lasting 1–2 h.	• 1–1.2 g CHO/kg body mass/h for first 4 h (if there are less than 8 h between training sessions).
Proteins	• 1.2–1.7 g/kg body mass/ day • 20–40 g of proteins (containing 700–3000 mg leucine) every 3–4 h to maximize MPS.			• 20 g of proteins or 9 g of EEA during and up to 2 h after training. • 0.3 g of proteins/kg body mass after training and every subsequent 3–5 h.
Fat	• Less than 30% of the energy value of the diet. • Not less than 20% of the dietary energy value to prevent deficiency of fat-soluble vitamins and essential fatty acids.			

Micro-nutrients compared to macronutrients are rarely as spoken about in the healthcare world. However, in regards to female players, they are considered very impactful for female soccer players. Some important micro-nutrients for female players are iron, calcium, and vitamin D.[4]

Iron is responsible for oxygen transport and energy production and its absorption through the diet is crucial for endurance.[15] Anemia, which is caused by iron deficiency, can result in a decrease in performance. Through the depletion of iron stores, this affects aerobic training, increases muscle fatigue, and decreases energetic efficiency during submaximal exercise.[6] This is especially very important during the time of a women's menstrual period where they lose more micronutrients than any other time.[2]

Calcium and vitamin D are very important nutrients for athletes due to their roles in maintaining bone health. Insufficient delivery to body can cause bone loss and increase the risk of bone damage and injury.[4] In women, calcium is especially important since it helps take part in blood clotting, muscle contractions, nerve transmission, protein utilization, and cellular communication.[4] Since many female athletes are prone to calcium and vitamin D deficiency, it is essential for healthcare providers to recommend supplementation of 800 UI/day of vitamin D and 2000 mg/day of calcium to decrease the incidence of injuries and loss of bone mass.[4]

Hydration is one of the main factors to determine how effective an athlete will perform during training and games. In order for an athlete to have a positive training performance, having the right fluid intake before, during, and after training is important. According to Dobrowolski et al, dehydration adversely affects muscle strength, endurance, motor coordination, mental performance, and thermoregulatory processes for an athlete.[4] The table below summarizes the recommended fluid intake for female soccer players:[4]

Hydration is one of the main factors to determine how effective an athlete will perform during training and games.

Table 2

Recommendation for fluid intake for female soccer players.

Timing	Recommendation
Before training	• Try to prevent dehydration before training by drinking fluids over the day. • 5–7 mL/kg body weight 4 h before training. • Additional 3–5 mL/kg body weight 2 h before starting exercises in the absence of urine or very dark urine.
During training	• Drink fluids to avoid 2% dehydration level. • Drink in small portions to not overfill stomach.
After training	• Drink 1.5 L of fluids for each 1 kg body mass loss. • Addition of electrolytes can replace those lost with sweat. • Presence of carbohydrates and proteins in drinks may increase intestinal fluid absorption.

In summary, female soccer players have specific nutritional needs that healthcare professionals need to be aware of. The energy needs of each players needs to be evaluated individually along with adequate intake of macro and micro-nutrients and appropriate hydration that will allow female players to maximize their physical performance and allowing for better recovery after training. Along with that, healthcare professional now have the tools and information to assist female athletes to allow them to not only be healthy but to score on and off the pitch.

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Nutrigenomics in Sports Pharmacy

By Dr. Ani Rostomyan, PharmD, BCPS, APh

AUTHOR BIO:

Dr. Ani Rostomyan is a Doctor of Pharmacy, Holistic Pharmacist and Functional Medicine Practitioner who specializes in Diabetes management,Gut health, Pharmacogenomics and Nutrigenomics consulting.
Dr. Ani discovered her calling in Precision Medicine and is the founder of SheAni, Inc, a concierge consulting company, focused on Pharmacogenomics and Nutrigenomics functional and holistic ways of improving overall health and well-being. Dr. Ani is on a mission to empower forward thinking health care providers, nutritionists and wellness practitioners to incorporate nutrigenomics into their practice to amplify their client results and increase their revenue.

Whether you're a weekend warrior or an Olympian athlete, nutrition is indeed vital to success in sports. The foods, fluids, and supplements athletes take in training and competition, have significant role in their performance, energy level, training endurance, body composition, and of course risk of illness or injury and the speed of recovery.

Individualized approach and guidance are an important factor in tailoring diets and supplements for athletes. Nutrigenomics has come forward as an emerging science to work collaboratively with sports nutrition guidelines, where athlete's personal genetic profile can be used as an additional tool in optimizing their athletic performance while decreasing injury risk.

Around 25.000 genes in human genome play significant roles in our individualized response to medications and nutrients and directly impact our health and performance.

Nutrigenomics will be the future of how we eat! Let's just say personalized diets are the future!

My first real interest in Nutrigenomics was sparked after watching the "The Dynamic Genome" documentary and how much our nutrition, lifestyle and genes are intertwined and involved in predisposition, or risk mitigation for certain chronic disease states, moreover how pivotal is epigenetics' role in this paradigm.

After the completion of Human Genome Project (1990-2003), where the DNA sequence of the entire human genome was mapped out, the era of precision medicine took off and nutrient-gene interplay concept was born.

Learning more about alleles, single nucleotide polymorphisms (SNP's), genome, haplotypes, coding and non-coding regions of DNA, and precision nutrition wasn't on my bucket list after graduating Pharmacy School, and only in recent years I dove into precision medicine and precision nutrition to understand why some of my patients weren't benefiting from same healthy nutritional recommendations according to well-known guidelines. My conclusion "One size does not fit all" soon became a reality and an aha moment!

The role of our **epigenome** , should be emphasized as well, which essentially is all the structural and chemical changes made to our DNA through methylation and what DNA methylation does is pretty much keeping your DNA curled in and protected in the nucleus, and not exposed, since more exposure will make more errors happening and higher chances of chronic disease occurrence.

What's even more fascinating to me, is different subtypes of a gene can make people to respond differently to certain components in our diet such as the lactose, gluten, caffeine, macronutrients like carbohydrates, fats, proteins, and of course vitamins, and minerals.

We all know someone who is lactose intolerant or cannot eat gluten. These differences between individuals can be explained by gene variations within the population. All through decades of scientific research it is becoming evident that genetic variations in the population and between individuals affect a wide variety of responses to key components of the human diet.

Minimally processed foods, fresh fruits and vegetables and balanced meal plans are good for everyone. Food and Nutrition guidelines designed by government agencies cover large groups of general population, but precision nutrition as a crucial part of individualized or personalized approach to health, takes into consideration genomic differences, epigenetics, patient's age, gender,

comorbidities, microbiome, and environmental influences as well.

Moreover, out of around 70 genetic markers linked to sports Nutrigenomics several of them have been involved in this field with promising evidence, which are, *ACE*, ACTN3, *BCMO1, FUT2, TFR2, UCP1, MTHFR*, *NOS3*, *PPARA*, *PPARG*, SOD2, FTO, ADRB2, *TRHR*.

The FTO gene is so called 'fat mass and obesity-associated gene', which has been linked to weight management and body composition. The role FTO gene plays in the body are related to energy expenditure and balance and metabolic rate. It is also expressed in regions of the brain that are involved in the regulation of energy intake. Recent studies show individual physical activity recommendations can significantly assist with weight loss and weight maintenance in individuals who carry the AA or GG variants of the FTO gene (markers of rs9939609 and rs1042713).

The ADRB2 gene encodes the Beta-2-Adrenergic Receptor, which belongs to a family of molecules that are involved in the stress response to substances like adrenaline. ADRB2 helps breakdown and mobilize fat cells, and its activity increases during exercise. Study of obese, sedentary persons by Lagou et al. mentions that variation in the ADRB2 gene predicted fat loss in response to cardiovascular exercise. Individuals, carrying variations of the FTO and/or ADRB2 gene, typically have an enhanced weight loss response from participation in higher levels of physical activity, therefore their physical activity recommendations, should be to perform moderate/vigorous cardiovascular activity in increments of 10 minutes or, for 30-60 minutes/day at least 6 days of the week, involving major muscle groups. Athletes whose Nutrigenomics report shows to be a carrier of these alleles are more likely to increase their lean mass, decrease fat mass and decrease body weight.

Pharmacists have become the healthcare paradigm shifters in the last years, in addition to elevating the profession we have moved on to exploring and leading towards more and more nontraditional roles and endeavors.

Knowledge on how food interacts with our genes, and how our body responds to these interferences, along with epigenetic factors, is what Nutrigenomics' promise consists of. This rapidly evolving scientific field is tailoring the framework for the genotype driven dietary recommendations, evidence-based solutions to dietary interventions and hopefully tackling chronic disease epidemic worldwide and addressing the value of preemptive medicine.

It is evident that Nutrigenomics and personalized medicine are paving the way and creating evidence based scientific insights for the prevention, treatment and management of chronic diseases and hold the promise of the ability to reduce risk factors for chronic illnesses regardless of our genetic blueprint. Using the power of Nutrigenomics/epigenetics, human microbiome, and our individual characteristics we can control our genetic destiny, negotiate with '' poorly working'' genes utilizing precision nutrition as an additional tool in the arsenal of personalized health approach. It is important to note that Nutrigenomics testing is not a stand-alone diagnostic tool to detect, diagnose and manage disease, rather it's another helpful approach to manage subpopulations, who carry significant polymorphisms altering their ability to metabolize nutrients in an efficient way.

Now how can Pharmacists position themselves as Nutrigenomics experts in Sports Pharmacy and stand out in our ever-evolving profession?

You, as a forward-thinking Pharmacist, certified in Nutrigenomics, can start serving your patients, who are athletes and not only, in a more meaningful way to help them first use food as medicine and eat what's right for them.

Importantly, your advice to patients should not be based solely on Nutrigenomic test results but use Nutrigenomics as an additional tool in your expert toolbox to find unanswered questions to health concerns that your patient may have been looking for years. You can be the greatest support tool and expert Nutrigenomics consultant for many primary care physicians who will greatly appreciate your expertise.

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All about the Macronutrients to Optimize Athlete Performance

By Keaton Higgins, Pharm.D. (c), ATC

AUTHOR BIO:

Keaton Higgins is a final-year pharmacy student at the University of Iowa and a certified athletic trainer, receiving his degree and accreditation through the University of Northern Iowa. During his time in pharmacy school, Keaton has worked tirelessly to discover opportunities that would allow him to integrate his passions of sports medicine and pharmacy into a fulfilling career. He regularly provides pharmacology lectures at his alma mater to pre-healthcare and athletic training students and will be presenting this summer at the National Athletic Training Association Clinical Symposia & AT Expo.

One of the easiest way to classify daily nutritional needs is by organizing them into one of two categories - macronutrients or micronutrients. Micronutrients are nutrients that our bodies need in smaller quantities and are typically referred to as vitamins and minerals. While essential to human nutrition, these substances are not produced by our bodies and need to be provided by well-rounded diets and/or supplement use. Macronutrients provide our bodies with energy and are needed in larger amounts than micronutrients. The three most important types of macronutrients include carbohydrates, protein and fats. While our bodies may produce some of their own macronutrients, the overwhelming demand for these macronutrients also requires well-rounded diets and/or supplementation to function. Due to the importance of these three macronutrients, there has been an overwhelming amount of research done in hopes of optimizing the benefits they provide. This is especially true for the elite athletic population with a focus on optimizing performance and recovery.

All athletes are different in terms of nutritional requirements, and as such there are no hard-and-fast rules to follow when attempting to identify ideal diets. Athletes follow special diets for myriad reasons that include health, religion, intolerances and many others. The also may require different diets depending on the type of sport they place or the nature of their training and performance. Endurance athletes have much different nutritional demands than power athletes. The amount of time spent training and the intensity of their training also plays a role in their nutritional needs. For example, the longer an athletes spends training during one session, the more carbohydrates they will need to sustain effective training.[2]

Due to all the aforementioned variables and many others, there are no widely accepted rules for daily nutritional needs. However, the Institute of Medicine has calculated acceptable macronutrient ranges that can be utilized in the pursuit of an ideal daily diet selection.[2] While the recommendations are listed as proportional to body weight and in relation to total daily energy intake, this is not the only criteria-for-use and thus the ranges should be utilized when personalizing nutritional intake. By not following these recommendations, athletes risk inadequate energy intake that can result in loss of muscle mass; menstrual dysfunction; loss of or failure to gain bone density; an increased risk of fatigue, injury, and illness; and a prolonged recovery process.[3]

Let's dive in further to these three main macronutrients individually.

Carbohydrates

Accounting for a whopping 45-65% of daily energy intake per IOM recommendations, carbohydrates are the main provider of fuel for our bodies. Sports nutrition guidelines indicate that it is necessary to use a large quantity of carbohydrates during training for athletes in sports related activity. However, too high of amounts may cause gastrointestinal intolerability due to its high osmolality.[1] Due to this fine line, it is recommended that athletes aim for 5-7 gram per kg (g/kg) of carbohydrates daily for moderate-intensity training, and 10-12 g/kg for high-intensity training.[2]

> Aiming for a good ratio of carbohydrates, proteins and fats is an ideal way of making sure our athletes are consuming their daily macronutrient goals.

The timing and quantity of carbohydrate intake is also important to consider for maximizing performance. Before a performance or training session, a meal consisting of complex carbohydrates (whole-wheat pasta, potatoes, oatmeal, etc.) eaten two-to-three hours is ideal to allow the body enough time to process and then utilize these as energy sources. If an athlete wishing to "carbo-load", they should aim for 8-10 g/kg per day for one to three days prior to the event.[5]

While exercising, it is important to maintain glucose levels to keep providing energy and prevent hypoglycemic events. A goal of 30 to 60 grams of simple carbohydrates (sugary snacks, sports drinks, etc.) per hour is recommended, especially for endurance athletes training for an hour or longer at a time, or the event is taking place in an extreme environment (altitude, heat, cold).[3]

Post-exercise, aim for 1-1.5 g/kg of carbohydrates in the first 30 minutes of recovery, and repeat this every two hours for four to six hours. Doing so will help replete glycogen storages adequately and will speed up recovery.

Protein

The IOM daily recommendation for adults is 10-35% of total energy intake. For sedentary adults, they recommend 0.8 g/kg of protein per day. But since athletes typically have more lean muscle mass and greater need for protein to aid in muscle repair following exercise, the IOM recommends a much higher daily protein intake. In fact, research suggests that endurance athletes should have a goal of 1.2-1.4 g/kg per day, and power athletes should aim for 1.6-1.8 g/kg per daily with the most intensive athletes requiring up to 2 g/kg of protein daily.[2] This is in line with current data that shows that muscle repair, remodeling adaptation generally ranges from 1.2-2 g/kg per day. Furthermore, the IOM recommends a daily goal of 1.8-2.7 g/kg of protein for individuals looking to lose weight while maintaining lean body mass. However, for athletes looking to undergo this process, it should be done during the offseason and under the direct supervision of a qualified healthcare professional.[4]

The timing of protein intake has long been a hot topic in the pursuit of optimizing recovery rates. Studies show that muscle protein synthesis (MPS)

is optimized when high-value protein providing 10 grams of essential amino acids is ingested in a two-hour window immediately following training. This can also be translated to roughly 15-25 grams of protein in one sitting. While these studies have shown that MPS is impacted by protein-timing, the long-term effects on mass and strength is unclear. However, research suggests that they are aided by efficient and timely protein intake.[4]

Like carbohydrates, it is important to achieve the recommend range of protein intake consistently to not only assist in physical recovery and muscle building, but to avoid losing muscle mass and other negative effects such as anemia, weakness, fatigue and decreased metabolism. Female athletes who choose to follow restrictive diets are at the greatest of low protein intake.[2] Good sources of protein to recommend include lean meats such as chicken and fish, dairy products, eggs and protein shakes. For those with restrictive diets, good options include beans, lentils, quinoa and plant-based protein supplements.[5]

Fats

Considered as the least-prioritized macronutrient of the three, the IOM recommends a 20-35% of total daily energy consumption. They also recommend "filling in the gaps" with fats after daily carbohydrate and protein goals are scheduled to be hit. Fats are necessary components of our diets and provide essential elements for our cells. They also provide crucial vitamins for our bodies to function properly such as vitamins E, A and D. Due to this, is not recommended to aim for fat-free or low-fat diets contributing to under 10-15% of our daily energy uptake. Research has suggested that in healthy individuals, there doesn't appear to be any health benefits of doing so.[2] However, it is also not typically recommended for athletes to follow high-fat diets (>35% total daily energy uptake). Not taking particular scenarios into account, research has suggested that high-fat intake reduces performance by limiting the availability of carbohydrates and its capacity for use in exercise.[3] However, some athletes may be insulin resistant and intolerant to carbohydrates, so a fat-centric diet would be favorable in these scenarios.

While fats are critical to growth and recovery, not all fats are the same. Diets should be heavily focused on unsaturated fat intake (90% of all fats or more) and limited in saturated fats. Trans fats should be avoided or scarcely congested. Unsaturated fats are abundant with essential fatty acids which are required by our bodies to produce several important biologic compounds with regulate our cardiovascular and immune systems, among others.[2] Sources of healthy fats include salmon, nuts, avocados, and coconut and olive oils.

Aiming for a good ratio of carbohydrates, proteins and fats is an ideal way of making sure our athletes are consuming their daily macronutrient goals. While all athletes are different with unique goals and training styles, we can provide personalized care by utilizing the ranges and recommendations discussed above. By doing so, we can provide yet another way to maximize our athletes' performance and recovery with the help of proper nutrition.

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Quick Reference Table

Macronutrients

Carbohydrates Recommendations	
Percentage of Total Calories from Carbohydrate	45-65% of Total Calories
Low-Intensity/Skill Based Activities lasting <1hour	3-5g/kg per day
Moderate-intensity training lasting ~1hour	5-7g/kg per day
High-volume training lasting 1-3 hours	6-10g/kg per day
Extreme volume lasting >4 hours	8-12g/kg per day
Carb intake 1-4hr prior to exercise	1-4g/kg of easily digestible sources
Carb intake during exercise	30-60g per hour if event lasts >1hour (up to 90g per hour if event lasts >3hours)
Carb intake after exercise	1-1.2g/kg each hour for 4 hours post-exercise
Fiber recommendation	30-38g/day (Men) ǀ 25g/day (Women)

Protein Recommendations	
RDA for protein	0.8 g/kg (sedentary individual)
% of total calories from protein	10-35 % of total calories
Building/maintaining muscle mass (ISSN position stand)	1.4 - 2.0g/kg
Protein content in a single dose (ISSN position stand)	0.25 g/kg OR 20-40g every 4-6 hours (protein pacing strategy)
Leucine content in a single dose (ISSN position stand)	700-3000mg
Dosing strategy (from ISSN position stand)	Protein intake every 3-4 hours throughout the day

Fats Recommendations	
Percentage of total calories from total fat	20-35% of total calories
Percentage of total calories from saturated fat	<7%, no more than 10% of total calories
Percentage of total calories from trans fat	<1% of total calories
Percentage of total calories from monounsaturated fat	15-20% of total calories
Percentage of total calories from polyunsaturated fat	10-15% of total calories
Percentage of total calories from omega-3 polyunsaturated fat	0.6-1.2% of total calories as alpha-linolenic acid 500mg of EPA + DHA
Omega-3 (alpha-linolenic acid) DRI	1.6 g/day (Men) ǀ 1.1 g/day (Women)
Percentage of total calories from omega-6 polyunsaturated fat	5-10% of total calories
Cholesterol Daily Value	300mg/day (regardless of kcal intake

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Micronutrients (Vitamins)

Vitamins			
Chemical name	Vitamins	Function	RDA
Choline		Responsible for creation of acetylcholine (aid with muscle function)	Men/Women: 425mg/day
Thiamin	B1 (water-soluble)	Energy transformation (coenzyme role) Necessary for metabolism of carbs and amino acids Membrane and nerve conduction	Men: 1.2mg/day Women: 1.1mg/day
Riboflavin	B2 (water-soluble)	Energy production (creates FAD+) Vitamin B6 metabolism and choline breakdown	Men: 1.3mg/day Women: 1.1mg/day
Niacin	B3 (water-soluble)	Used to create NAD+ Converts food into glucose Helps create fatty acids and cholesterol	Men: 16mg/day Women: 14mg/day
Pantothenic acid	B5 (water-soluble)	Creation of coenzyme A	Men: 1.3mg/day Women: 1.2mg/day
Pyridoxal Phosphate	B6 (water-soluble)	Needed for normal brain function Coenzyme for transamination and deamination (Protein metabolism)	Men: 1.3mg/day Women: 1.2mg/day
Biotin	B7 (water-soluble)	Essential for breakdown of amino acids and fatty acids Essential for breakdown of leucine	Men/Women: 300mcg/day
Folate	B9 (water-soluble)	Amino acid metabolism Helps with the development of red blood cells Purine and pyrimidine synthesis	Men/Women: 400micrograms/day Pregnant: 800micrograms/day
Cobalamin	B12 (water-soluble)	Helps maintain healthy nerve cells Helps in production of DNA and RNA Production of succinyl-COA in the breakdown of essential amino acids	Men/Women: 2.4mcg/day
Ascorbic Acid	C (water-soluble)	'Cement' for connective tissues Anti-oxidant Wound healing Iron absorption Co-factor in neurotransmitter creation	Men: 90mg/day Women: 75mg/day
Retinol/Retinal/Retinoic acid	A (fat-soluble)	Vision Maintenance of cornea, mucous membrane and skin Bone and tooth growth	Men: 900micrograms/day RAE Women: 700micrograms/day RAE
Cholecalciferol	D (fat-soluble)	Aids in calcium & phosphorous absorption, bone building Increases troponin C in muscles	Men/Women: 10-20 mcg/day
Alpha-Tocopherol	E (fat-soluble)	Anti-oxidant	Men/Women: 15mg/day
Phylloquinone	K (fat-soluble)	Aids in calcium binding to protein	Men: 120micrograms/day Women: 90micrograms/day

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