Sports Pharmacy

SPORTSRXNEWS
DECODING THE SCIENCE OF ELITE HUMAN PERFORMANCE

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Special Populations

Breathe Easy While Pursuing Passion: Asthma Management in Athletes

An Overlooked Condition in Athletes: Hypothyroidism

Managing Type 1 Diabetes as a Competitive Athlete

Letter from The President

Dear Sports Pharmacy Magazine Subscribers,

Looking back on 2023, we have had the privilege of exploring cutting-edge developments in sports pharmacy, sharing valuable insights from experts, and delving into the latest research shaping the landscape. The positive feedback and engagement from our community have fueled our passion for delivering high-quality content that informs, educates, and inspires. It has been an incredible journey, and we are immensely grateful for the overwhelming support and enthusiasm we have received from our readers, contributors, and partners.

In line with our commitment to enhancing your experience, I am thrilled to announce the launch of our newest endeavor, the Sports Pharmacy Network (SPN). We are confident that SPN will become an integral part of your journey in staying at the forefront of clinical sports pharmacy knowledge. We invite you to explore the platform and make the most of the enhanced and premium features designed with you, our dedicated readers, in mind.

Once again, thank you for being an essential part of our community. Your continued support propels us forward, and we are genuinely excited about the future of Sports Pharmacy Magazine. Here's to another year of growth, innovation, and shared passion for the fascinating intersection of sports and pharmacy.

Wishing you a splendid New Year filled with joy, achievement, and good health.

Warm regards,

Brandon Welch, PharmD, CPh, CWC
President, Sports Pharmacy Network
Clinical Sports Pharmacist

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Breathe Easy While Pursuing Passion:
Asthma Management in Athletes.

By Nilhan Uzman, BPharm

AUTHORS BIO:

Nilhan Uzman is a pharmacist who combines her passion for sports with her profession, and practices as a sports pharmacist. She works with recreational and professional athletes and teams, specializing in preventive health and performance in endurance sports. She is committed to empowering athletes to gain better control on their health, well-being and protecting clean sports.

Asthma is a common health and performance concern within the world of sports, with a high prevalence amongst athletes. In athletes, especially those engaging in endurance exercises, managing asthma is critical to their overall health and performance. Pharmacists who are providing care to athletes should understand the intricacies of asthma development in athletes, treatment options, and the unique challenges posed by anti-doping regulations to professional athletes who have asthma.

This article aims to delve into the foundations of asthma management in athletes, providing insights into how athletes develop asthma, the non-pharmacological and pharmacological treatment options available, the challenges athletes face during treatment, and anti-doping regulations regarding treatment options.

Exercise-induced asthma and exercise-induced bronchoconstriction

Asthma is a heterogeneous disease characterized by chronic airway inflammation. It is defined by a history of respiratory symptoms such as wheezing, shortness of breath, chest tightness, and cough, which vary over time and in intensity, together with variable expiratory airflow limitation.[1]

While airway inflammation and airway hyperresponsiveness characterize asthma, these are not necessary or sufficient to make the diagnosis. There should be evidence of variable airflow limitation from bronchodilator reversibility testing or other tests.

The respiratory demands of sports can lead to airway constriction, coughing, and shortness of breath, affecting amateur and elite athletes. Respiratory symptoms generally start after a few years of exercise, and the symptoms may occur during or after exercise.[2]

Exercise-induced asthma is a transient narrowing of the airways with exercise that is reversible after bronchodilator intake in a patient with asthma.

Exercise-induced bronchoconstriction (EIB) occurs after exercise and the athlete may not have a prior diagnosis of asthma or even other respiratory symptoms. EIB occurs due to the tendency of the airways to constrict more easily and forcefully as a response to a wide variety of bronchoconstrictor stimuli. This is called airway hyperresponsiveness (AHR).

Objective measures are needed to establish a diagnosis of asthma and co-morbid conditions mimicking asthma or associated with asthma should be identified and treated.

Asthma prevalence amongst athletes

While the prevalence of asthma in athletes varies according to country, age, and sport, asthma prevalence is approximately six times higher in athletes compared to the general population.[3-7]

A study done after the 2004 and 2008 Olympics and World Aquatics Championships in 2005, 2007, and 2009 demonstrated that the prevalence of asthma is higher in aquatic disciplines. Asthma prevalence is higher in winter sports

Asthma symptoms may be denied, not recognized, or be considered insufficient to be treated in the athlete population. This leads to poor recognition or difficulties in assessing asthma symptoms.

compared to summer sports and higher in endurance sports compared to power & strength sports.[8-9]

Mechanisms of asthma development in athletes

Asthma in athletes is a specific phenotype.

Cold and dry air, chlorine in indoor pools, aeroallergens in indoor training centers, and air pollution are all possible stimuli that can cause respiratory symptoms in different sports training environments. Hyperventilation during exercise causes excess heat in airways and causes dehydration. Dehydrated airways have increased penetration of pollutants and allergens. This causes epithelial damage with loss of protective mediators, microvascular leak, and a trigger of the repair process.

A 2012 study showed that swimmers have higher deposition of collagen I and III, compared to athletes with mild asthmas, due to the repair process activated in epithelial cells.[10]

The epithelial damage changes the contractile properties of the airway smooth muscle and causes airway remodeling. As a result, asymptomatic airway hyperresponsiveness develops and this leads to symptomatic asthma.

Asthma management in athletes

Asthma symptoms may be denied, not recognized, or be considered insufficient to be treated in the athlete population. This leads to poor recognition or difficulties in assessing asthma symptoms. In the athletic population, despite bronchoconstriction, expiratory flows may look normal due to high baseline value. To confirm the diagnosis, appropriate diagnostic tests, possibly more than one type of diagnostic test, should be applied, including repeating tests in a high-intensity training period or in an environment where a suspected trigger is present.

Following the diagnosis of asthma, for successful management in athletes, it is important to assess the presence of comorbid conditions, such as rhinitis or gastroesophageal reflux, and offer treatment.

For each athlete and sport , triggers and inducers of asthma need to be identified and preventative measures or non-pharmacological treatments offered. For example with swimmers, chloramines in the air should be reduced. This can be achieved by applying strict hygiene measures by the athletes and checking that chlorine levels are as low as safely possible to minimize chloramine formation in pools. All athletes should avoid high levels of exposure to air pollutants and allergens during training where possible. Winter athletes should avoid exercising in the extreme cold and consider using a face mask.

Appropriate pharmacological treatment should be identified for athletes while continuously measuring treatment efficacy and implementing measures to prevent EIB and a reduction in lung function.

Education of the athlete to self-manage and adhere to their treatment is required for the success of the asthma treatment. Pharmacists can apply their expertise in this area, considering symptom relief and performance optimization.

Pharmacists can educate athletes on self-monitoring for asthma control, follow up on treatment plans to avoid exacerbations, educate athletes on inhaler technique, assess and promote medication adherence, and monitor and report side effects. Pharmacological asthma treatments are subject to anti-doping regulations, and pharmacists are ideally positioned to advise on these regulations and check the requirements for a Therapeutic Exemption Use (TEU).

Pharmacological treatment options

Prescribers should follow current general guidelines to assess the medication needs of athletes.[1] The general guidance is to provide rescue therapy with a short-acting beta-2 agonist on demand at the minimum dose and frequency.

The first choice in maintenance therapy is inhaled corticosteroids (ICS), where second choice is leukotriene-receptor antagonists. When asthma is uncontrolled, a combined ICS and inhaled long-acting beta agonist or a leukotriene-receptor antagonist is prescribed, while checking general measures and contribution of coexisting contributions.

Tolerance to beta-2 agonists occurs in all asthmatic patients, which is a concern in athletes because their daily training schedules require frequent use of beta-2 agonists. Frequent use may decrease the broncho-protective effects of beta-2 agonists and increase the severity of bronchoconstriction induced by exercise due to the downregulation of airway beta-2 receptors.

Pharmacists should guide athletes to avoid using long-acting beta-2 agonists alone and limit their use when needed to avoid development of tolerance. Athletes may be referred to a physician to reassess asthma, coexisting conditions, and triggers, or to adjust the maintenance treatment.

Pharmacists are ideally positioned to educate athletes and monitor the correct usage, dosing, and adherence to asthma medications to avoid tolerance and exacerbation of symptoms, thus poor health and performance. An overview of pharmacists role in asthma management is shown in Figure 1[11]:

Prohibited status of asthma medications

The World Anti-Doping Agency (WADA) establishes global standards to protect clean sports while ensuring athlete health. WADA maintains a list of prohibited substances, including certain asthma medications. However, athletes with a legitimate medical need for these substances can apply for a TUE to continue their treatment [12-13].

According to the WADA Prohibited List (2023) prohibited list[13]:

All selective and non-selective beta-2 agonists, oral or injectable, including all optical isomers, are prohibited. Including, but not limited to:

- Formoterol
- Salbutamol
- Salmeterol
- Terbutaline
- Vilanterol

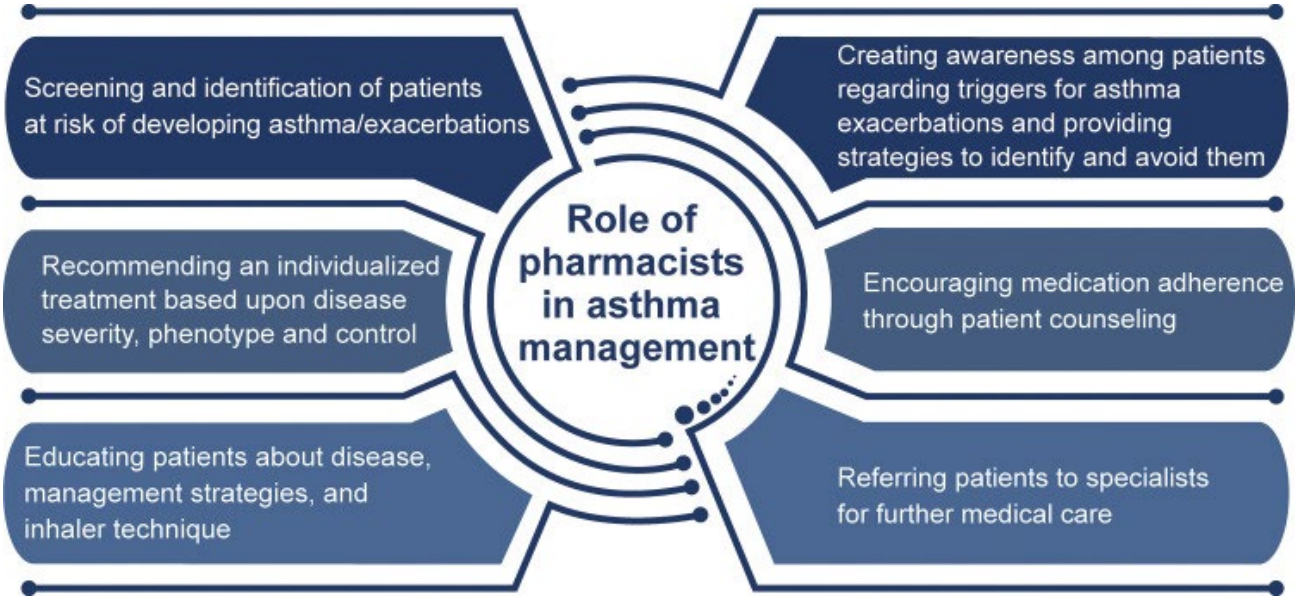

Figure 1: Role of pharmacists in asthma management

> Tolerance to beta-2 agonists occurs in all asthmatic patients, which is a concern in athletes because their daily training schedules require frequent use of beta-2 agonists.

WADA introduced some exceptions to asthma medications:

- Inhaled salbutamol: maximum 1600 micrograms over 24 hours in divided doses not to exceed 600 micrograms over 8 hours starting from any dose;
- Inhaled formoterol: maximum delivered dose of 54 micrograms over 24 hours;
- Inhaled salmeterol: maximum 200 micrograms over 24 hours;
- Inhaled vilanterol: maximum 25 micrograms over 24 hours.

According to WADA, the presence in urine of salbutamol more than 1000 ng/mL or formoterol more than 40 ng/mL is not consistent with the therapeutic use of these substances. This would be considered an Adverse Analytical Finding unless the athlete proves, through a controlled pharmacokinetic study, that the abnormal result was the consequence of a therapeutic dose (inhalation) up to the maximum dose indicated above.
Therapeutic doses of inhaled beta-2 agonists do not provide performance-enhancing effects. The maximum doses listed above is higher than above the recommended therapeutic doses. However, the use of salbutamol with a nebulizer may cause urine concentrations to go over 1000 ng/mL, and this would require a TUE. It is crucial for pharmacists to advise athletes to adhere to appropriate doses at all times and describe the difference between delivered and metered doses in inhalers.

Combined inhaled ICS and long-acting beta-agonists may contain conditional or prohibited beta-2 agonists. Athletes should inform their physician or pharmacist about their anti-doping requirements to avoid inadvertent positive results.

While the use of oral or rectal glucocorticoids such as prednisone in competition is prohibited, other routes of administration, such as inhaled, are not prohibited when used within the licensed doses and therapeutic indications. Severe asthma attacks may require oral corticosteroid treatment, and this requires a TUE.
Where necessary, a TUE may be granted for the athlete to use a prohibited substance for the treatment of asthma in the case of meeting the following conditions:

- The prohibited substance is needed to treat a diagnosed medical condition supported by relevant clinical evidence;

> From understanding asthma development in athletes to exploring diverse treatment options, athletes and their healthcare teams must work collaboratively.

- The therapeutic use of the prohibited substance will not, on the balance of probabilities, produce any additional enhancement of performance beyond what might be anticipated by a return to the athlete's normal state of health following the treatment of the medical condition;
- The prohibited substance is an indicated treatment for the medical condition, and there is no reasonable permitted therapeutic alternative;
- The necessity for using the prohibited substance is not a consequence, wholly or in part, of the prior use (without a TUE) of a substance or method that was prohibited at the time of such use.

Asthma is not a barrier to athletic success

Many globally renowned athletes have successfully managed asthma throughout their careers which can foster a positive and hopeful outlook for athletes dealing with asthma. The Turkish free diver and multiple world record holder Şahika Ercümen suffered from severe asthma as a child and started her diving journey to beat the condition. English soccer player David Beckham has been living with asthma since he was a young boy and he had a 20 year career, winning 19 major trophies. Effective treatment has allowed them to excel and thrive in their sports.

Conclusion

In conclusion, management of asthma in athletes requires a holistic and individualized approach. From understanding asthma development in athletes to exploring diverse treatment options, athletes and their healthcare teams must work collaboratively. The delicate balance between managing symptoms, treatment, and adhering to anti-doping regulations adds an additional layer of complexity. As sports pharmacists, it is imperative to provide comprehensive pharmaceutical care, ensuring athletes can breathe easy and steer clear from doping violations while pursuing their passion.

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SPECTRA LIFE SCIENCES

Eating Disorders in Athletic & Fitness Populations – Let's Get PROACTIVE!

By Sean Casey, RD, CSCS

AUTHORS BIO:

Sean Casey is a registered dietitian and performance health coach who works with everyone from middle/high school athletes to Olympians including an Olympic Gold Medalist. His expertise is sought after internationally, and he has traveled to 15 countries to help clients reach their athletic potential through nutrition, physical training, and recovery techniques. Additionally, Sean heads up the science team for Hometown Pharmacy of Wisconsin, a group of 65 independent pharmacies focused on helping people reduce the need for medications (safely) or prevent them from ever needing them in the first place through food, movement, sleep, and stress management.

Soundbites of Life– Fleeting vs. Perennials

As one goes about life, he or she hears thousands of soundbites. Some of these are fleeting in nature whereas others take hold in the soil of one's mind where they grow, flower, seed, and become perennials present within one's daily thoughts.

Growing up, my father repeatedly sowed a soundbite that took hold and remains with me to this day:

"Life is not about sports; sports are about life. Although there is more to life than sports, the lessons you learn while participating in them (teamwork, discipline, hard work, sacrifice, etc) will live on once your formal athletic career is over."

As the years have passed, my father's words ring truer and truer in my daily thoughts. The lessons I learned participating in competitive sports have shaped my life in many beneficial ways. .

Although the above example represents a positive scenario, not all sowed soundbites yield such outcomes.

Over the last 20 years, I have transitioned from a competitive youth athlete into a dietitian and physical preparation coach who works with everyone from adolescent athletes to Olympians. I've seen many soundbites contribute to developing disordered eating patterns on both a clinical and subclinical level.

This article will focus on disordered eating patterns, ways to promote a culture centered on healthy relationships with food and movement, along with strategies for recognizing and appropriately addressing suspected disordered eating patterns.

Disordered Eating Patterns vs. Eating Disorders

Due to the presence of many unhealthy eating patterns that don't necessarily qualify as a clinical eating disorder, many sports medicine professionals, including myself, prefer the term 'disordered eating patterns' as opposed to 'eating disorders'. Going forward, disordered eating patterns will be used as a general term which includes anorexia, bulimia, orthorexia, as well as subclinical eating disorders.

Types of Disordered Eating Patterns

Many types of disordered eating patterns exist. The two most recognized ones are anorexia and bulimia nervosa. Anorexia nervosa is characterized by restricted eating with an intense fear of becoming fat, along with body dysmorphia.[1] Bulimia nervosa involves binge eating cycles followed by purging cycles to rid self of said food.

Orthorexia nervosa (ON) is a less recognized eating disorder that was first referenced in a 1997 article entitled "Health Food Junkie," which appeared in the lay press publication *Yoga Journal*.[2] ON is characterized by restricting food intake based on beliefs related to the 'purity' or 'cleanliness' of food instead of limiting food intake based on fear of gaining weight. In other words, if a food doesn't fall within one's paradigm of 'clean eating,' it cannot be eaten.

Examples of ON behaviors include excessive preoccupation with cultivation

Eating disorders are quite common in sport. Ranges have varied from ~ 1.1-49.2% depending on the athletic population studied.

methods, food preparation, and ingredients present within a given food.[2] ON is also characterized by a strong sense of shame and impurity when eating food that goes against one's established clean eating paradigm.

Finally, sports medicine professionals should be aware of a condition known as Relative Energy Deficiency in Sport (RED-S), which refers to:

"*… impaired physiological functioning caused by a relative energy deficiency and includes, but is not limited to, impairments of metabolic rate, menstrual function, bone health, immunity, protein synthesis, and cardiovascular health.*"[3]

RED-S is characterized by having Low Energy Availability (LEA), which refers to failure to consume enough calories relative to energy output.[3] Using the equation below, the ideal Energy Availability (EA) is 45 kcal/kg of Fat Free Mass (FFM). An energy availability of < 30 kcal/kg FFM is associated with negative health issues mentioned above. It's important to be aware that RED-S can take place with or without an actual eating disorder present.

EA = (Total Energy Intake – Exercise Energy Expenditure)/FFM in KG[1]

RED-S is accompanied by alterations in many hormone levels, including testosterone, estrogen, progesterone, and various thyroid hormone alterations. For an in-depth discussion on thyroid hormones and how they impact health, refer to Dr. Jessica Beal's article in this same issue of Sports Pharmacy Magazine focusings on hypothyroidism in athletes.

Prevalence of Disordered Eating Patterns

Eating disorders are quite common in sport. Ranges have varied from ~ 1.1-49.2% depending on the athletic population studied.[4] In personal experience working with athletes and fitness enthusiasts, conservatively speaking, believe it is closer to ~ 40-70% of individuals displaying symptoms of disordered eating patterns.

Individuals who participate in sports where being lean is emphasized such as endurance, aesthetics, and weight-dependent competitions, are at even higher risk of having an eating disorder.[5] For instance, a study completed by Torstveit et al., looked at 'lean' vs. 'non-lean' elite female athletes, those participating in the former had significantly higher rates of clinical eating disorders (46.7%) vs. both non-lean (19.8%) as well as the control group (21.4%).[6]

Concerning orthorexia nervosa, prevalence is similarly high. Somewhat paradoxically, those whom individuals often turn to for nutritional advice (dietitians, fitness/yoga instructors, etc.) are often at the highest risk of displaying signs and symptoms of ON.[7] For example, Varga states that between 35-57.8% of individuals belonging to high-risk groups (healthcare professionals and performing artists) displayed orthorexia behaviors. Observations of a different population consisting of 131 'active gym members' and 110 'Crossfitters,' Mavrandrea and Gonidakis noted that 10% of the former and 11.7% of the latter displayed ON symptoms.[8] Worth noting, diagnositic criteria for ON are still being debated in the scientific literature.

> As sports medicine professionals, it's imperative to work together to create a culture that proactively promotes healthy relationships with both food and exercise amongst its community members.

Creating a Culture of Healthy Eating

Due to both the short- and long-term consequences of anorexia, bulimia, orthorexia, and other disordered food patterns, it's imperative that a collaborative team approach is taken to create a culture promoting healthy eating behaviors. This collaborative team ideally includes athletes, parents, coaches, and a sports medicine team (sports pharmacists, athletic trainers, dietitians, psychologists, physical therapists, and doctors).

In creating this culture, educational emphasis should include establishing a healthy relationship with food and body image, recognition of signs/symptoms of an eating disorder, and finally, establishing policies and procedures for how to handle athletes with eating disorders. Let's look at these more in-depth.

Establishing a Healthy Relationship with Food & Body Image

Establishing a healthy relationship with food begins with the realization that no item is necessarily evil. For example, even the much-maligned Twinkie is a source of carbohydrates that can serve as a quick energy source, especially if there are no other sources available during the pre- and post-workout time periods.

Educational emphasis must be placed on how protein, carbohydrates, dietary fats, micronutrients, and overall energy intake all work together to optimize athletic performance. Dietary myths such as 'carbs make one fat,' 'protein makes females bulky,' etc. and additional nutrition concerns should be addressed. Of equal importance, the sports medicine professional should provide the athlete with pragmatic examples of how he/she can achieve his/her dietary goal amounts.

Particularly when working with high school and collegiate athletes as well as females of childbearing age, it's important to help them understand not only the acute effects of underfueling the body (i.e., decreased energy, immune function, overall performance) but also the downstream ramifications of failure to properly fuel the body (brittle bones, difficulty conceiving kids, etc.). Minus conception, males can suffer all of the aforementioned issues too.

In helping to establish a positive relationship with body image, it's important to remind athletes that much of what they see on social media is completely fake and/or highly photoshopped. Building off the concept of having a healthy image of one's body, encourage athletes not to get too caught up in how much they weigh on a scale; rather, focus on the type of fueling plan needed to perform their best and reach performance goals. Especially when working with ladies, showing them images of highly successful female athletes with bigger framed bodies, such as Serena Williams, can help them gain confidence i n having a potentially larger physique.

Identifying and Addressing Cases of Suspected Signs of Disordered Eating Patterns

To effectively treat disordered eating patterns, it's important to be aware of common signs or symptoms and treat them immediately. There are some common signs or warnings that sports medicine professionals, coaches, and parents should be aware of.

Signs of Disordered Eating Patterns:

- Eating Alone
- Going to the bathroom after every meal
- Loss of menstrual cycle (females)
- Frequently injured and/or sick
- Slow to recover from training sessions
- Frequently cold
- Excessive exercise
- Preoccupation with food
- Critical of other people's eating habits
- Negative self-talk as it relates to his/her body, such as "*I feel so fat.*"
- Perfectionism
- Abnormal lab values (nutrient, hormonal, etc)

Working within a pharmacy setting, sports pharmacists should be mindful if they hear excessive concern about weight gain or loss from a patient while taking medications known to cause these issues (ex – stimulants, antidepressants, antipsychotics, etc). If deemed appropriate, the sports pharmacists should help connect them with appropriate healthcare teammates (medical doctor, dietitian, or psychologist) who can further help them.

It's important that sports medicine teams and athletic organizations have policies and procedures in place to allow for an effective intervention strategy when a potential eating disorder has been identified or suspected.

For those looking for a great resource on strategies to intervene and support an athlete working through disordered eating patterns, I strongly recommend reviewing the 'Coach & Trainer Toolkit' provided free of charge by the National Eating Disorders Association. It can be found

on the following link:
www.nationaleatingdisorders.org/learn/help/coaches-trainers

Wrapping Things Up

Disordered eating patterns, including anorexia, bulimia, orthorexia, and others, are pervasive throughout the athletic and fitness world. As sports medicine professionals, it's imperative to work together to create a culture that proactively promotes healthy relationships with both food and exercise amongst its community members.

Additionally, working as part of a collaborative healthcare team, it's important to establish policies/procedures for when suspected eating disorders are present, as well as how support will be provided to ensure optimal care.

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An Overlooked Condition in Athletes: Hypothyroidism

By Dr. Jessica Beal-Stahl, PharmD

AUTHORS BIO:

Dr. Jessica Beal-Stahl, PharmD, is the founder of The Athlete's Pharmacist company, tying her passions of 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, and Sports Nutrition.

Fatigue, depression, and malaise… what athlete wants to sign up for this trifecta? Unfortunately, many athletes presenting with dwindling performance and failure to build muscle have unknowingly signed up for these symptoms due to either undiagnosed or improperly managed hypothyroidism.

Although it may seem surprising to hear this, it makes perfect sense. Most athletes appear fit, train hard, and have busy schedules, which naturally have these same symptoms. However, just because you're a hard-training athlete or fitness enthusiast doesn't mean you're doomed. Many top athletes have won medals and set records even after being diagnosed with hypothyroidism.

Basics of the Thyroid

The thyroid gland is a butterfly-shaped gland at the base of your throat, which plays a vital role in thousands of ongoing chemical reactions in each cell of your body. It is often considered the master regulator of body processes, including energy levels, metabolism, growth and development, and body temperature.

The causes of thyroid problems, either causing it to speed up or slow down, are often complex and rarely the result of one single event. Medical conditions, medications, toxic environmental exposures, and autoimmune diseases are some of the leading causes of thyroid problems.

About 13 million people, or 1 in 300 people, in the United States are affected by the most common thyroid disease, hypothyroidism (the thyroid runs "too slow").[1,2] Hypothyroidism also has many causes; however, for our purposes today, the focus will be primarily on hypothyroidism, which occurs when the thyroid doesn't produce enough thyroid hormone.

Thyroid disease is generally a slow progression.[3] The majority of hypothyroidism occurs because of an autoimmune disorder (Hashimoto's), in which your body's antibodies attack your thyroid, leading to a decrease in function, and if nothing is done, the thyroid is eventually destroyed.[3]

Typical Hypothyroid Symptoms[4]		
Fatigue	Weight gain/Inability to lose weight	Hair loss, brittle, or dry hair
Cold intolerance	Abnormal menses	Constipation
Muscle aches and cramps	Dry skin	Depression/Irritability

Our body also produces reverse T3 (rT3) from T4. Unlike T3, which is active and regulates metabolism, rT3 is inactive and blocks T3 from working. The body produces more rT3 to conserve energy when it is under stress or illness.

The thyroid axis works on a negative feedback loop to balance circulating levels of the response hormone thyroxine (T4) in normal ranges. A negative feedback loop means that as something increases, the production of whatever is causing the increase slows down. So, picture a bowl of water that you want to keep full but not let overflow. When the volume of water increases, you decrease the addition of more water; if the bowl empties (volume decreases), you increase the addition or more – hence negative feedback.

The thyroid is part of the hypothalamus-pituitary-thyroid (HPT) axis. This axis includes the hypothalamus, which secretes thyroid-releasing hormone (TRH); the pituitary gland, which secretes thyroid stimulating hormones (TSH); and the thyroid gland, which secretes Thyroxine (T4) and Triiodothyronine (T3). When the blood levels of T4 and T3 increase, they inhibit the secretion of TRH and TSH, thus reducing the stimulation of the thyroid gland to continue to release T4 and T3.

Our body also produces reverse T3 (rT3) from T4. Unlike T3, which is active and regulates metabolism, rT3 is inactive and blocks T3 from working. The body produces more rT3 to conserve energy when it is under stress or illness.

Consecutively raised TSH levels, often 4.5 mU/mL or higher, paired with levels of T4 below the normal range, indicate primary hypothyroidism. Some patients will present with labs where TSH is raised above the upper end of normal, yet T4 is in range, defined as subclinical hypothyroidism. Conversely, levels of TSH below the normal range with paired levels of T4 above the upper end of the normal range indicate an overactive thyroid (hyperthyroidism).[5]

Thyroid Lab Values[6]

Standard Ranges of Thyroid Hormones		Optimal Ranges
TSH	0.45 - 4.5 mU/mL	1.0 - 2.0 mU/mL
Free T4	0.82 - 1.77 ng/dL	1.45 - 1.77 ng/dL
Free t3	2.0 - 4.4 pg/mL	3.4 - 4.2 pg/mL

A complete thyroid panel, not just TSH, should be a part of annual bloodwork. A full thyroid panel includes TSH, Free T4, Free T3, TPO, and Tg, giving a more complete picture. Thyroid peroxidase (TPO) antibodies and thyroglobulin (Tg) refer to antibodies that can help determine if auto-immune-induced hypothyroidism is present. Interestingly, as many as 10% of women are hypothyroid.[7] Although researchers are unsure why more women have hypothyroidism, it's hypothesized that females may be more affected by autoimmune conditions vs. males, leading to greater prevalence.[7]

A complete thyroid panel is recommended because testing TSH can be falsely decreased or elevated due to different factors. Birth control, glucocorticoids, aspirin, antidepressants, depression, pregnancy, aging, fasting, and exercise can all potentially cause diminished TSH levels. On the other hand, stress, emotional arousal, cold exposure, sleep deprivation, severe illness, iodine, lithium, and high doses of antihistamines can all potentially increase TSH levels.[8,9,10]

Also of note, patients may present with low-end range TSH and T4, known as "non-thyroidal illness/sick euthyroid." In other words, the negative feedback loop to maintain hormone homeostasis is not functionally normal and is often due to functional hypothalamic-pituitary-endocrine gland suppression. In athletes, this is seen with the clinical syndrome of Relative Energy Deficiency in Sport (RED-s). In female athletes, RED-S often presents as functional hypothalamic amenorrhea, with low FSH and LH and low estrogen. In turn, the body's metabolic rate is down-regulated to "save energy" characterized by low-end range TSH, T4, and T3.[11, 12] In such a situation, giving exogenous Thyroxine will override this physiological response to down-regulate metabolic rate and potentially increase energy deficit.

The psychological and physical pressures experienced by athletes can sometimes have reversible impacts on the HPT axis. On the other hand, athletes can also experience medical conditions that impact this endocrine axis. Recognition of these situations provides insights and a deeper understanding of overall endocrine function in this athletic population.

Studies have demonstrated that intense training will transiently decrease one's T3 levels, there is a paucity of evidence indicating that elite training volumes will lead to chronic suppression. Studies have demonstrated that TSH may transiently decrease due to acute stresses placed on the body but will normalize.[13, 14]

For example, in a study by Schmid et al., researchers found that after maximal exercise in runners, TSH dropped before returning to normal post-training. It should be noted that this shift was subtle, increasing from 1.35 to 1.5 at the end of exercise.[15] In another study, researchers found that TSH levels changed from 1.69 at 45%, 1.78 at 70%, and 1.89 at 90% HR max during exercise. So again, exercise changes things acutely, but not significantly.[16]

Although the changes are slight, it is recommended to get blood work on an easy day or following a rest day to avoid false readings.

Treating the Hypothyroidism

First, identify the underlying cause of the thyroid imbalance. For many, this will mean managing an autoimmune attack on the thyroid gland. For some athletes, monitoring overall stress and implementing strategies to reduce its effects (nutrition, sleep, training, etc.) is a great first step.

Patients will always require supplemental thyroid hormone to function if their thyroid is surgically removed or if they have Hashimoto's. If clinically hypothyroid, the solution is most often to take supplemental thyroid hormone.

The most prescribed drug is levothyroxine (Synthroid or Levoxyl), which is synthetic T4. Other treatment options are synthetic T3 (liothyronine, Cytomel) or desiccated pig thyroid (Armor or NP Thyroid). Most prescribers use levothyroxine, which is converted to T3 in the body, unless conversion issues exist. In the alternative medicine world, some providers use desiccated pig or compounded thyroid more frequently, but it presents its own challenges as it is harder to control and dose.

Once a patient-athlete starts taking the medication, it's all about fine-tuning the dose. The goal is essentially to regulate TSH to a "normal" level. The consensus by several endocrinology societies is targeting TSH between 1 and 1.5 mU/mL.[17] There are currently no return-to-play guidelines to help guide athletes after diagnosis.

The following nutrients are also essential for normal thyroid function and may need to be supplemented:

- **Vitamin D**: Anyone with a thyroid condition, especially autoimmune thyroid disease, must check vitamin D levels. Vitamin D is associated with autoimmune thyroid disease and supplementation can be of benefit.
- **Iodine:** The most crucial nutrient for thyroid function. The thyroid gland is the only place in the body that uses iodine; it is used to manufacture T4 and T3. We can't live without it, yet too much can cause serious thyroid problems.
- **Zinc:** When deficient, levels of T3 and T4 may be lower; replenishing zinc can normalize levels of these hormones while potentially assisting with the conversion of T4 to T3.
- **Selenium:** The thyroid concentrates more selenium than any other organ in the body. Selenium supports the conversion of T4 to T3. Low selenium has been associated with thyroid disease and plays an important protective role against oxidation in the thyroid gland.
- **L-Tyrosine:** L-Tyrosine is an amino acid from which the thyroid hormone backbone is made.
- **Iodine:** Is combined with tyrosine inside the thyroid to make thyroid hormones.

Thyroid As a Banned Substance?

Abuse of androgens and erythropoietin has led to hormones being the most effective and frequent class of ergogenic substances prohibited in elite sports by the WADA. At present, thyroid hormone (TH) abuse is not prohibited, but its prevalence among elite athletes and non-prohibited status remains controversial.

In a widely publicized case, former Nike Oregon Project coach Alberto Salazar allegedly pushed for the use of asthma and thyroid medication for performance enhancement. There was a growing suspicion that healthy runners were being encouraged to take thyroid drugs to lose weight or act as a stimulant.[18]

The performance-enhancing effects of thyroid medication are dubious, yet neither levothyroxine nor liothyronine are on the World Anti-Doping Agency's (WADA) banned list.[19]

Administering levothyroxine to those with normal thyroid function or too high of a dose for those clinically diagnosed as hypothyroid can potentially have severe side effects, overstimulating one's sympathetic nervous system. These side effects include intense anxiety, inability to sleep, weight loss, increased appetite, heart racing, muscle weakness, and increased risk of cardiac arrhythmias.

Training and Recovering with Hypothyroidism

Training with a thyroid disorder can be complicated. Athletes often feel like they are on the edge of overtraining, even if their medication is spot on and they're focusing on training volume and recovery.

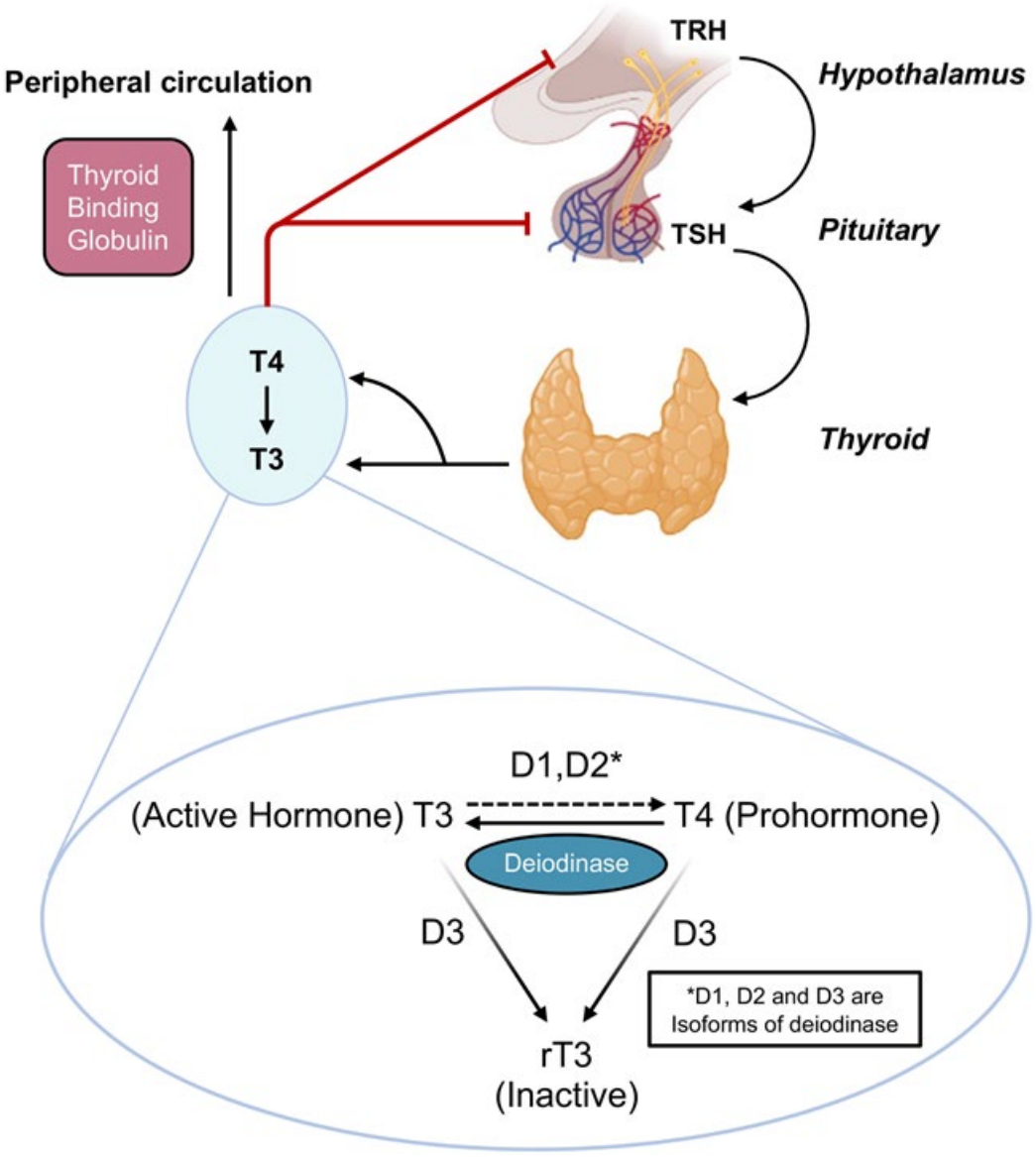
Just because TSH is "optimal" doesn't mean the hormonal system is optimal. A pill taken once a day releases the hormone all at once, which is entirely different from an average person whose thyroid

> The complaint of fatigue or decreased performance may be a sign of subclinical or overt thyroid disease. There is currently a lack of evidence-based guidance for both treatment and how to adjust training for athletes with thyroid disease.

secretes hormones on demand. For example, if an athlete has a huge stress response, the body calls for thyroid production, and a typical patient's body gets a jolt of secreted T4 instantly. On the other hand, an autoimmune or hypothyroid patient doesn't; they have what is left from their morning dose to call upon.

Hypothyroid athletes must train a little differently than their peers. Although they may not train as hard or as long, some find they can still be just as fit and competitive through prudent training, a careful diet, and listening to their body instead of blindly pushing themselves too hard.

It's important to note that studies will demonstrate improved performance going from overt hypothyroid to euthyroid. That's because the disease is being corrected, and the body is balanced. Anyone would be useless without thyroid production. For athletes



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who have hypothyroidism, it's similar to managing chronic conditions like asthma or diabetes in a way. The goal is to bring them closer to normal, not make them superhuman.

For most athletes, the physical manifestations of thyroid disease are often varied, and clinical suspicion remains the trigger for further investigation. The complaint of fatigue or decreased performance may be a sign of subclinical or overt thyroid disease. There is currently a lack of evidence-based guidance for both treatment and how to adjust training for athletes with thyroid disease. The best advice for athletes diagnosed with or suspected of thyroid issues is to find a good endocrinologist who understands athletes, closely monitor their lab levels, and learn to listen to their body.

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Managing Type 1 Diabetes as a Competitive Athlete

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

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Dr. Brandon K. Welch is an experienced licensed wellness 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. He is the wellness pharmacist for Baptist Health where he works collaboratively with the Miami Dolphin's and Florida Panther's team physician to help enhance athletic performance and reduce risk of illness. His passion in connecting metabolic health with human performance 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, metabolic health, sports nutrition, sports medicine, 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.

Managing Type 1 Diabetes as a Competitive Athlete

Athletes living with Type 1 Diabetes (T1D) can thrive in competitive sports. A personalized approach is required to ensure the metabolic energy required for peak performance and safe blood glucose levels are maintained.

The considerations for glycemic management in athletes differ from those whose physical activity is low to moderate. Athletes with diabetes who complete everyday gym workouts or who compete in games need to adjust their carbohydrate intake, blood glucose readings, and insulin levels on workout and game days. The adjustments athletes need to make are daily, sometimes throughout the day, and require a far more deliberately strategic approach.

There's no one-size-fits-all equation, but the top considerations are below.

#1 Blood Glucose Monitoring

The average patient with diabetes needs to monitor their blood glucose levels before meals and snacks and before and after standard workouts. On average, an athlete with diabetes may need to check their blood sugars upward of 6 times a day[27]**.** In football, one can check the blood glucose twice prior to the start of the game—at the start of warm-ups, then 30 minutes later before the start of the actual game—then again at halftime, and later at the end of the game. Each testing regimen should be personalized toward the athlete. Most opt for continuous glucose monitoring systems (CGMs) that sync with their wearable technology of choice. These systems provide real-time data and automated alerts, simplifying daily insulin and carbohydrate management.

#2 Unique Considerations For Female Athletes

Female athletes should track their menstrual cycle. Beyond the higher risk of menstrual cycle dysfunction in sports including dance, gymnastics, soccer, cycling, swimming, and boxing[1]—fluctuating hormones influence glycemic response. Halfway through the menstrual cycle (the luteal phase), higher progesterone levels can lead to insulin resistance referred to as luteal phase insulin resistance[2]. This creates an increased risk of hyperglycemia (high blood glucose). Reduced post-workout carbohydrates is likely to be suggested[3].

#3 Managing Hyperglycemia and Hypoglycemia

Balancing insulin doses with exercise intensity and duration is crucial to preventing hypoglycemia (low blood glucose) or hyperglycemia. To minimize the risk of hypoglycemia for physical activities lasting between 30 to 60 minutes, athletes may be advised to increase carbohydrate intake by 8 to 20 grams[4]. This may be in combination with *decreased* insulin. For prolonged training and aerobic activities, between 70 to 90 grams of simple carbohydrates per hour[5].

Working closely with medical professionals who specialize in the unique needs of diabetic athletes is recommended. This often includes both a physician, dietitian or even a clinical sports pharmacist.

> Athletes with T1D must work closely with a medical team that specializes in the unique considerations of high-intensity training.

#4 Carbohydrate Intake

Carbohydrate intake plays a significant role in maintaining stable blood glucose levels during exercise. Athletes should consume carbohydrates before, during, and after physical activity to provide energy and prevent hypoglycemia. The amount and timing of carbohydrate intake can vary greatly from one day to the next, depending on the intensity and duration of exercise.

It varies by sport, but 40% of athletes maintain the standard 45% to 65% carbohydrate macronutrient consumption (200+ grams per day)[6]. However, 30% of athletes consciously moderate their carbohydrates, with an intake of 100 to 200 grams per day. The remaining percentage of athletes implement a low-carb intake (up to 100 grams per day) or very-low-carb intake (40 grams per day) regimen. [7]

#5 Time in Range (TIR)

Glycemic TIR targets for athletes with T1D are the same as non-athletes, which is a minimum of 70% when training and while at rest. How to achieve this must be personalized to the sport, daily training, and individual athlete. The aim is typically a TIR of 3.9–10.0mmol/L, with less than 4% below 3.9mmol/L, and less than 1% below 3.0mmol/L[8].

#6 Hydration

Taking a proactive approach to dehydration is of increased importance for all athletes. Water is required to maintain blood volume and a safe body temperature by replenishing fluids lost while sweating.[9] However, athletes with T1D must be even more cautious about avoiding dehydration. Dehydration causes blood glucose levels to fluctuate. Therefore, athletes must hydrate before, during, and after training and game days. Due to their higher risk for hyperglycemia, athletes with diabetes require more hydration than athletes without diabetes.[10] When it comes to replenishing electrolytes, standard sports beverages have high amounts of sugar. Sugar-free, and artificial sweetener-free electrolyte are more appropriate options for athletes with T1D.

#7 Team Support

Even those who play solo sports must inform, educate, and lean on their coaches, training partners, and teammates. This goes beyond notifying them that they have diabetes, to educating them on:

- Signs of hyperglycemia
- Signs of hypoglycemia
- Their emergency action plan
- Their personalized training plan

#8 Mental Health

Living with diabetes is stressful. Competitive athletics is stressful. Day-to-day life presents fluctuating stressors. Athletes with T1D must prioritize balance and self-care as a proactive and reactive approach to stress. This should include networking with other athletes with diabetes, in-person or virtually to form a strong network of supportive peers.

Increased Risk of Hyperinsulinemia and Hypoinsulinemia

Competitive athletes are at an increased risk for both hyperinsulinemia and hypoinsulinemia.[11]

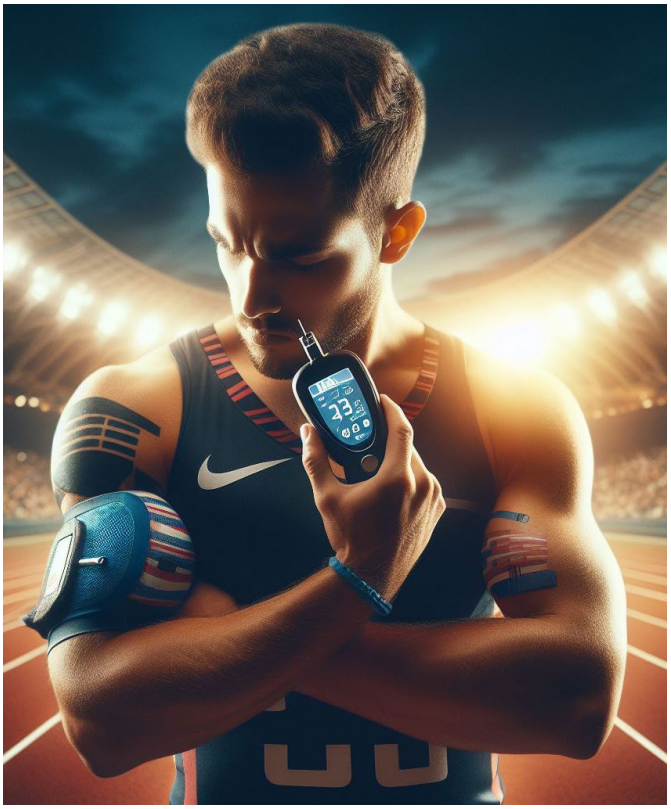
In athletes:

- **Hyperinsulinemia** is when the body releases an excessive amount of insulin. Due to their intense

and extended training time, athletes are at risk of hyperinsulinemia[12]. A combination of reduced basal and/or prandial insulin dosing and/or increased carbohydrate intake is the most common strategy. This is typically achieved by reducing insulin by 50% to 80% for 1.5 hours before training.[13]

- **Hypoinsulinemia** is when the body experiences a rapid decrease in insulin levels. Due to the transition from intense training to rest, athletes are at risk for hyperinsulinemia post-training.Minimizing the risk of post-workout hypoinsulinemia is achieved by increasing carbohydrate intake for all workouts greater than 60 minutes.[15] This must be personalized to the individual athlete and training schedule, but is typically 70 to 90 grams of simple carbohydrates per hour.[16]

T1D presents unique challenges for competitive athletes. Athletes can excel by personalizing their glycemic management and building a supportive athletic and medical team.



To minimize finger pricks, many athletes utilize a CGM. Athletes should keep extra supplies on hand. This includes any combination of:

- Glucose meter
- Lancing device
- Lancets
- CGM and supplies
- Insulin needles
- Pump supplies
- Carbohydrate snack
- Glucagon/glucose gel
- Ketone meter
- Medical identification

Insulin Delivery Methods for Athletes

Athletes with diabetes should explore their full range of insulin delivery methods. This isn't only for ease and convenience but for health and athletic performance. To ensure optimal performance and glycemic management, athletes typically need to adjust their insulin more than the average patient with diabetes.

Common delivery methods include:

- **Multiple Daily Injections[17]:** This is the age-old delivery method for long-acting basal insulin and rapid-acting insulin. It's a flexible option that allows athletes to easily adjust dosing.
- **Insulin Pump[18]:** An insulin pump delivers a continuous supply of rapid-acting insulin through a small tube. While highly effective, pumps can be disconnected when playing high-contact sports.
- **Hybrid Closed-Loop Systems[19]:** Also known as artificial pancreas systems, these systems refer to synced CGMs and insulin pumps. Again, pumps aren't ideal for high-contact sports.
- **Inhaled Insulin:** A common option for on-the-go and mealtime dosing, insulin is inhaled instead of injected. While injection-free, it's not the right option for everyone.

Personalized Frameworks

Athletes with T1D must work closely with a medical team that specializes in the unique considerations of high-intensity training. This often includes a physician, clinical sports pharmacist and dietitian who personalize how they manage their basal and bolus insulin doses, hypoglycemia, hyperglycemia, hydration, and stress. Although monitoring needs to be personalized, there are some standard frameworks[20] that can be utilized.

Conclusion

T1D presents unique challenges for competitive athletes. Athletes can excel by personalizing their glycemic management and building a supportive athletic and medical team. The key points above are essential for building a foundation in which athletes can achieve optimal health and peak athletic performance. These foundational elements don't replace the need for routine medical care and creating a personalized diabetic care plan isn't something athletes should attempt alone.

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