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5.1 Background

The Olympic motto is “Citius, Altius, Fortius,” that is, Faster, Higher, Stronger. Throughout sports, technology has changed the face of performance but technology isn’t the only thing pushing athletes forward. The gene pool within competitive sports most certainly has changed. In the past, coaches had the idea that the average body type was the best for all athletic endeavors: medium height, medium weight, no matter what the sport was. But that idea started to fade away in years. Sports scientists and coaches realized that rather than the average body type, you want highly specialized bodies that fit into certain sports. For this reason, a form of artificial selection took place. And now, small details make the difference between good athletes and great athletes.

5.2 Physiological Aspects

Professional athletes must keep their bodies in excellent condition. Even those players whose sports are seasonal must be concerned about fitness all through the year. They must perform their jobs at the highest level at all times.

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Professional athletes also face the constant threat of injuries that could end their careers.

Not all injuries can be avoided, but the severity and probability of injury can be reduced through proper risk management. Risk management is the overall process of identifying risk factors, assessing, and controlling risks.

5.3 Musculoskeletal Aspects

Prevention starts with knowing your risk. Risk factors are traditionally divided into two main categories: internal (athlete-related) risk factors and external (environmental) risk factors. However, merely to establish the internal and external risk factors for sports injuries is not enough. Sports injuries result from a complex interaction of multiple risk factors and events of which only a fraction has been identified.

5.3.1 Internal Risk Factors

- Age (maturation, aging)
- Body composition (body weight, fat mass, BMD, anthropometry)
- Health (history of previous injury, joint instability)
- Physical fitness (muscle strength/power, maximal oxygen uptake, joint ROM)
- Skill level (specific technique, postural stability)

5.3.2 External Risk Factors

- Sport-specific (body contact, repetitive actions, risk actions; jumps, sprints)
- Training (dynamic loads, volume, warm-up, methods of training, recovery)
- Equipment (protections, field)

5.3.3 Prevention of Injury

- Analysis (health, performance)
- Training
- Nutrition
- Equipment

Recent studies have shown that the main factors affecting the appearance of lesions are overtraining, incorrect sports technique, inadequate nutrition, and factors related to the athlete's behavior, whereas the main injury prevention strategies are muscle strengthening, nutritional counseling, and guidance.

5.4 General Medical Aspects

5.4.1 Analysis

Quality performance analysis and feedback to the athlete is a cornerstone of any high performance program. Technology combined with quality coaching to ensure that games and performance analysis is completed to the highest levels possible. Specific programs and analysis types include:

- Individual and team games analysis including video, statistical feedback
- Biomechanical skills analysis
- GPS and related game and training intensity analysis
- Hydration
- Body composition
- Athlete wellbeing
- Effectiveness of recovery methods
- Strength and power analysis

Laboratory tests are also commonly used in periodic evaluation of the healthy athlete. Owing to the metabolic stress of training for sport, laboratory results in elite athletes may differ from the general population. The sports medicine clinician must be astute as to how training affects laboratory results and the clinical relevance of abnormal findings. Laboratory testing is an important component of the management of the athletic patient and should be considered by the clinician working in the sports medicine setting. Laboratory testing of the elite athlete has been described as a routine part of health screening. Here are some laboratory tests:

- (a) CBC With Differential.
- (b) Comprehensive Metabolic Panel.
- (c) Iron Panel

Iron-deficiency anemia is the most common cause of anemia in athletes and presents with common signs such as fatigue, headache, joint pain, and weakness, which could otherwise be overlooked as a sign of overtraining or dehydration.

- (d) Lipid Panel

The high-density lipoprotein is often abnormally high in well-trained athletes. Careful consideration should be given when prescribing statins to athletes, as it has been reported that most athletes can't tolerate their use without muscular side effects.

- (e) Vitamin B12

Those on energy-restrictive diets, those with heavy alcohol use, and strict vegetarians should consider supplementation. An athlete who is deficient in vitamin B12 may have decreased cognitive function causing impaired concentration, or compromised aerobic capacity resulting in decreased athletic performance.

- (f) Vitamin D

Vitamin D levels help determine if bone weakness, bone malformation, or abnormal metabolism of calcium is occurring as a result of a deficiency or excess of vitamin D. Recent literature suggests that athletic performance may be affected by vitamin D as well (Fig. 5.1). Vitamin D has been shown

Fig. 5.1 Vitamin D levels are important for athletic performance and prevention of tendon-muscle injuries



to increase the size and number of type II fast twitch muscle fibers and is directly associated with musculoskeletal performance and the prevention of bone loss.

(g) Thyroid Panel

Thyroid stimulating hormone is an excellent screening test to determine if chronic athlete fatigue, weakness, weight loss or gain, depression/anxiety, or sleep disturbances.

(h) Urinalysis

Dehydration not only reduces athletic performance and places athletes at risk of health problems. Monitoring hydration has significant value in maximizing performance dur-

ing training and competition. It also offers medical personnel the opportunity to reduce health risks in situations where athletes engage in intentional weight loss. Simple non-invasive techniques, including weight monitoring and urine tests can provide useful information.

(i) Creatine Kinase

In the athletic patient population, the elevation of these specific studies may not define overtraining but is rather as a sign of acute muscle breakdown and stress seen with exercise or heavy training and serves as a small piece of the diagnosis of overtraining syndromes.

5.5 Pitfalls in This Population

5.5.1 Training

Recently, the relationship between training load and injuries in sport has been discussed. Challenging the dogma that high training loads cause high injury rates, many studies across a range of sports have shown that excellent fitness reduces injury risk. Well-structured intensive training can have protective effects against noncontact soft-tissue injuries. The regeneration piece is often missing from other programs but it's really the key for avoiding injury and improving overall performance.

Overreaching is a temporary condition that occurs in response to heavy or intense loads. The symptoms of overreaching are generally feeling unwell, disrupted sleep, and mood fluctuations. It does not have any significant impact on athletic performance. If an athlete recognizes the condition of overreaching in the early stages and allows their body to regenerate properly, their condition will return to normal. If an athlete does not allow their body to recover completely, and continues to train hard, that would lead to overtraining.

Overtraining syndrome is a condition that occurs when the body is pushed beyond its natural ability to recover. Overtraining leads to burnout. It produces chronic overuse injuries that in some ways are more troublesome than those caused by trauma because overuse injuries aren't always diagnosed immediately. Fatigue from overtraining can also make an athlete more vulnerable to contact injuries.

Here are some ways that how the elites train longer, recover quicker, steer clear of injuries, and perform better.

- Hypoxic chamber

A hypoxic chamber is a sealed room in which the oxygen content of the air is reduced to simulate being at altitude. It's well known that for endurance athletes, altitude training is a great way of improving fitness, by enhancing the body's ability to take in and transport oxygen.

- Precision hydration

Precision hydration is a harnessed technology originally developed to monitor sodium loss in

cystic fibrosis sufferers to assess sweat content in athletes. The sweat is collected, analyzed, and the appropriate sodium concentration for sports hydration is prescribed from a range of carbohydrate-free soluble electrolyte tablets, which come in concentrations ranging from 250–1500 mg.

- Gravity-defying running (altering G force)

This technology empowers people to move in new ways and without pain—to recover mobility, improve wellness, and enhance physical performance.

- Mental skills training

Psychological skills training—mastering distraction, conquering nerves, overcoming fears, and instilling confidence—has become an accepted and valued part of an elite athlete's preparation for competition.

- Physiological testing

Laboratory-based testing has long been routine for elite athletes, to identify strengths and weaknesses, monitor progress and assess the effects of training. Maximum oxygen volume and lactate threshold assessments are commonly made in elite athletes. Other tool is the saliva test, which monitors cortisol levels every first day of the week. In the case of chronic fatigue, cortisol levels drop at salvia, which remains us that the athlete has fatigue and overtraining might cause musculoskeletal injuries.

- Cryotherapy

Cryotherapy comes from the Greek word “cryo,” meaning cold, and “therapeia,” meaning cure. Many elite athletes are beginning to utilize “whole body cryotherapy”—the exposure of the entire body to extreme cold, which is thought to decrease inflammation and pain and promote healing and recovery.

- 3D gait analysis

Laboratory-based gait analysis allows even tiny errors to be spotted, which might be the cause of current or future injuries.

5.5.2 Nutrition

Nutrition plays a major role in both performance and recovery, which is why athletes must plan

what they eat and drink carefully. A registered sports dietician or sport and exercise nutritionist is now an integral part of any performance team working in elite-level sport. Nutrition goals vary greatly between sports, depending on the physiological demands of that sport.

The first step is to thoroughly assess the athlete’s training program, goals, and current diet, in order to plan a nutrition and hydration program that meets their individual needs. There is great value in getting specific advice and guidance on how to relate these guidelines to athletes’ own individual circumstances and sport.

5.5.3 Equipment

One of the most important aspects in sports medicine and in prevention of athletic injuries is protective gear. Knowledge on different types of athletic equipment available may help physical therapist in proper selection and fitting of the

equipment, as this can play a key role in preventing injuries.

Biometric gadgets are transforming the way the world’s elite athletes are trained. Wearable sensors provide on-the-go physiological measurements, which previously required costly lab equipment. Those wearable sensors are now helping players both improve performance and ward off injury. Here are some biometric gadgets that are changing the game for elite athletes:

- Electronic wristbands measure sleep quality and quantity, which can help predict a player’s reaction time for the next day. Coaches can use an associated online tool to monitor the sleep patterns and fatigue of professional athletes.
- There are some devices that their sensors precisely record a player’s movement on the field or court by GPS (Fig. 5.2). The device, which sits over the upper back inside a compression

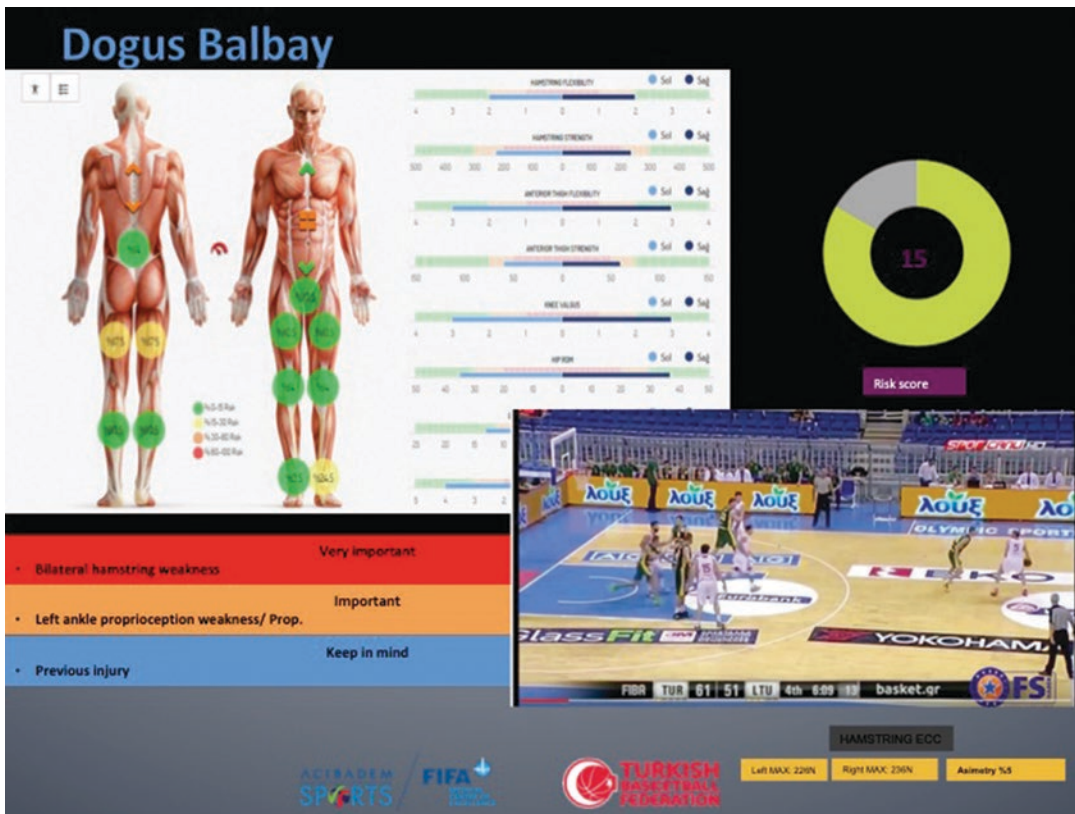


Fig. 5.2 There are some devices that their sensors precisely record a player’s movement on the field or court by GPS

garment, monitors acceleration, deceleration, change of direction, jump height, and distance traveled, among other metrics. Coaches use the data to keep tabs on how hard players are working and to prevent injuries resulting from overtraining.

- There are numerous tests and analyses to improve athletic performance.
- With a proper guidance and the help of technology, the Olympic motto can be achieved. “Citius, Altius, Fortius,” that is, Faster, Higher, Stronger.

5.6 Fact Box

- Professional athletes must have specialized bodies that fit into certain sports.
- Professional athletes face the constant threat of injuries that could end their careers.
- Risk analysis and management is the key to prevent injuries.
- Recent studies have shown that;
 - The main injury risk factors are overtraining, incorrect sports technique, inadequate nutrition.
 - The main injury prevention strategies are muscle strengthening, nutritional counseling, and guidance.

Recommended References

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