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Applications of Sports Medicine – Nutrition, Recovery, Physical Therapy and Biological Frameworks

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ABSTRACT

Injuries can be a big hurdle for athletes, impacting their performance and their longevity in their respective sports. Proper physical therapy can play an important role in allowing the athlete to function properly and reducing the chance of reinjury. This paper goes into different aspects, emphasizing rehabilitation methods based on injury severity. For instance, surgeries are necessary and distinct therapy protocols compared to minor sprains. Nutrition is another crucial factor, with studies highlighting the role of macronutrients like carbohydrates in increased energy levels and delayed fatigue onset. Also, wearable devices offer innovative avenues for monitoring athlete health and performance which allows personalized training programs and injury prevention strategies. Biomedical advancements, such as cartilage transplants, provide new hope for injured athletes by facilitating quick recovery and faster return to sport protocol. In this publication, we will emphasize the various impacts from physical therapy, nutrition, and technological innovations. This analysis will give a great approach to enhance athletic performance and mitigate injury risks.

Introduction

Sports Medicine is crucial for athletes' performance and is often overlooked due to its lack of prevalence to the sports fans. Although it has been overlooked, it is starting to gain more attention with more injuries to big time athletes and the speedy recoveries that they endure to get back to their sport. The industry is growing at a historical rate and new technological advancements and elite physical therapy are put in place to help these athletes recover at a never seen before speed. Not only are they recovering fast but they are also working on injury prevention with these athletes so that they are not faced with the same issues. Athletes are getting paid at a high rate and these sports orthopedics are being needed more and more to make sure that these athletes are able to stay on the field and be able to perform their job, which is resulting in more job openings for professional team doctors. Team doctors will usually also be in charge of nutrition to make sure the athlete stays healthy and also basic health needs such as prescribing medications for the athlete. This industry has grown tremendously because of major technological improvements that have helped these doctors in further evaluating these athletes.

Comprehensive Analysis of Physical Therapy, Nutrition and Athletic Performance

Injuries to any athlete can be detrimental and can result in a loss of function in that certain body part. To get this athlete back to playing like themselves they must do strengthening and mobility exercises to help the joint/muscle function like it did prior to the injury. Also this will help in preventing the injury to reoccur to the athlete and will increase the chances of this athlete staying healthy for longer periods of time. For example, an

injury to the ankle will result in the ankle ligament being much weaker resulting in the possibility of reinjuring it so it is crucial to do physical therapy so that you can strengthen the ankle so that there is no reinjury. To support this, in an article by Suzanne T. Hawson, the author says "Recreational and elite athletes alike sustain foot and ankle injuries that can hamper their ability to return to sport." which proves that it can be difficult to come back the same without performing the proper physical therapy. (Hawson, 2011) There are different types of physical therapy for each injury and depending on the severity of the injury as well. For example, when an athlete undergoes surgery there will be a different course of physical therapy then an ankle sprain with no ligament damage. As authored in the National Library of Medicine, "physical therapy has been shown to be critical to both surgical and non-surgical recovery and remains the most effective intervention clinicians can prescribe to regain strength, range of motion, and patient satisfaction." On the other hand, researchers argue that when faced with a grade-1 ankle sprain, it may be optimal to rest the area by avoiding any impending activity or pressure that can lead to pain, by applying ice packs to the area under professional guidance to ensure proper mobility is secured, with the help of doctors and physical therapists that recommend the usage of an ankle brace.

Genetic Susceptibility to Injuries for Athletes

While injuries that occur can be dated to environmental factors, genetic susceptibility can greatly lead to the performance impairment, or optimal performance of athletes. A group of researchers tackled the theory behind the "Genetic Ceiling" model to unveil an analysis of expert performance development and injury risk. (Tucker et al., 2012) The "Genetic Ceiling" model comes to bolster the idea that was issued by Sir Francis Galton, who had concluded that the heritability model can apply to both mental and physical capacity. For instance, researchers had argued that genetic variants would predispose an individual to certain levels of success – however, at the same time, the "Practice Sufficiency Model" had proposed that expert performance athletically is only the "sole result of accumulating many hours of deliberate practice." (Tucker et al., 2012) Additionally, it is essential to acknowledge that while environmental factors are imperative for the success and optimal performance of athletes, at the same time, the "nature versus nurture" model arguably indicates that both, or in other words, the harmony of environmental and genetic factors may be essential in paving the way for successful agility and physical performance of athletes in the industry.

In conjunction to this, another group of researchers looked into the intersections in the multifaceted interaction between muscle performance-related genes as well as the actual athletic performance. When a group of researchers analyzed 100 elite endurance athletes, and their genotype scores were classified, researchers identified that the total genotype score (TGS) of non-injured athletes presented itself as a mean of 68.263, whilst injured athletes presented a score of 50.037. (Delgado, 2022) These outcomes suggest that more research could tap into the efficacy of whether genetic susceptibility is one that researchers should analyze.

Sports Cardiology, Respiratory System and Health

Researchers have witnessed how regular exercise can definitely improve an athlete's cardiac function in terms of the positive implications that exercise can have on positively revamping the heart functions. For instance, from deriving research findings from an athlete's ECG which can track one's physiological and training-related changes, researchers witnessed how the cardiac markers are temporarily elevated after an exhausting endurance-exercise, without any notable damage related to the myocardial component; subsequently, improving and increasing one's life expectancy. (Baman et al., 2010) In terms of the biological anatomy related to exercise and the heart, researchers witnessed that dynamic forms of exercise can lead to a rise in the systolic blood pressure, whereby the pressures in the pulmonary artery are kept consistent, remaining in the normal range, even when

an individual is under exercise pressure. (Baman et al., 2010) However, while exercise is typically positively correlated with enhancing the functions of the heart, at the same time, some research findings have identified how coronary artery disease has become an emerging concern. Although presence and prevalence of coronary artery disease is very limited in young competitive athletes, for athletes that are over age 40, overexertion of physical exercise can lead to such cardiac failures, where physicians and cardiologists with expertise arguably advise not to pursue overexertion if proper screening and examination has not yet been conducted. Other heart diseases that have been prevalent in athletes, specifically young athletes on the other hand, include mitral regurgitation, aortic stenosis as well as aortic regurgitation. (Scharhag et al., 2013) Thus, it is imperative to ensure that echocardiogram results are properly obtained, to ensure that the statistical chances of being diagnosed with a valvular heart disease are limited, for early-stage athletes who have just begun their ventures in pursuing competitive sports.

Sports Nutrition and Performance

Sports Nutrition is overlooked in athletes' performance as what they put into their body can be very important as in how it affects their body and performance. In the research findings proposed by Kerksick et al, findings proposed that athletes consume carbohydrates before, during and after workouts to make sure they are at full energy. (Kerksick et al., 2018) This further proves how the proper macronutrients put in the body will maximize its performance and help the athlete perform at a high level. Another statistic that supports this from the research of Beck is that onset fatigue is delayed by 2-3% which means that these athletes can perform at a high level without getting tired as fast and will be able to play for longer periods of time. It can also help promote recovery,helps the athlete's body adapt to workouts, improves body composition and strength, enhances concentration, helps maintain healthy immune functions, reduces the chance of injury and reduces the risk of heat illness and stomach-related diseases. As other macronutrients are important for proper energy, carbohydrates would be the ideal option. For enhanced muscle growth it can be important to have a proper protein intake as this can help with muscle growth. Fats can also be helpful as they can help athletes who participate in longer duration and lower intensity sports like cross country. Most importantly water intake is the biggest key to athlete performance as dehydration can result in headaches, cramping and more serious complications like heat stroke.

Biomedical Applications of Wearable and Medical Devices for Optimal Performance

Wearable devices and sensors have been receiving recognition in the industry, as these advancements in technology have enabled athletes to utilize these movement sensors and tools to better optimize their health and athletic performance. Researchers Crabtree and Rhodes defined wearable devices as a "computer that is always with you, is comfortable and easy to keep and use". (Gago et al., 2019) In the current global market, wearable devices have garnered a significant traction from 28.8M units sold to now over 222.9M expected to be sold in 2019. (Gago et al., 2019) When analyzing results, they identified that either a wearable device that is equipped with sensors, or a commercial device can be utilized to ensure that there is optimal physical performance. Intrinsically, as part of the wearable devices, the most crucial components that are part of the devices include the movement sensors, integrated sensors, heart rate monitors as well as temperature monitor; with such results, researchers are then able to convert into an external data log. For instance, a recent advancement made with multimodal integrated sensors have made it easier for researchers to test fitness activities, as well as physiological and movement profiles in athletes. By adapting a wireless device that can be attached to electrocardiography electrodes, these tools now have implemented change in the ways in which physicians, coaches and training staff are able to monitor, transcribe and reevaluate physiological movements and parameters, as well as in

providing appropriate training programs that could reduce potential causes of injury, as well as a better performance optimization. (Li et al., 2016)

Biomedical Advancements of Cartilage Transplants for Injured Athletes

Due to radical advancements, research has paved the way for injured athletes to gain comprehensive support with biomedical advancements that facilitate the functions and recovery of athletes that are impacted by high-impact sports. For instance, researchers unveiled how injuries that happen to the anterior cruciate ligament are more observed in soccer players, which can subsequently increase the risk of an athlete developing an articular cartilage lesion. (Steinwachs et al., 2012) With many clinical and surgical advancements and approaches, researchers have been able to repair cartilage defects. For instance, a technique was developed based upon tissue regeneration, where the cell suspension was implanted under a "collagen membrane". These tissues that led to a regeneration in areas led to techniques where osteochondral cylinders were harvested from the joint to address such defects.

In regards to subsequent implications that such cartilage transplants have led, another group of researchers identified that there was a 73% return-to-sport rate in an analysis consisting of 1363 patients, where athletes were proposed to recover in their muscle functions in different courses of procedures. (Krych et al., 2016) For instance, athletes were witnessed to return to sports at an average of 9-months recovery following a cartilage restoration surgery, with OAT being associated with the shortest rehabilitation time of 5 months as compared to 12 months. Although findings need to be dependent upon different procedures, age and lesion size, researchers witnessed that the form of surgery, notably known as "osteochondral autograft transfer" offered the most rapid and efficient form of recovery in preinjury athletes. (Krych et al., 2016)

Discussion, Ethics, Limitations

In terms of the ethical implications that this may have on the industry, sports medicine has captivated the attention of many physicians, pathologists, kinesiologists as well as nutritions that must comprehensively come together to identify the best course of action in helping with the everyday functions, mobility and physical performances of athletes. However, one potential weakness associated with this is that some of these results that were deduced stem from 2014-2016, when biomedical advancements were limited. Additionally, while some research findings focused on the rehabilitation and physical mobility of athletes, it is essential to consider that athletes have different recovery times, and longitudinal studies could help combat such weakness in these research areas. Thus, for incoming research studies, experimental research and empirical findings derived from longitudinal courses of research may be optimal, to ensure that these limitations are addressed. At the same time, there are certain aspects to consider with regards to applying some of these medical findings, as each athlete enduring a different prognosis or symptom related to their physical injuries may benefit from different biomedical tools or applications. Thus, it is crucial to evaluate various biomedical apps, devices and physiological monitoring systems by biomedical engineers, physicians and kinesiologists before diversifying these results for a larger population.

Conclusion

In conclusion, there are various medical frameworks for how athletic performance can be better mobilized through proper and intricate guidance of physical therapy, nutrition and athletic development. At the same time, it is essential for researchers to pay attention to genetic susceptibility that can increase the likelihood of athletes to face injuries, the various components to sports science like sports cardiology, as well as sports nutrition —

all of which are essential to the proper maintenance, recovery, and athletic performance of individuals. As researchers continue to witness significant medical advancements in the sector of kinesiology and sports science, researchers can pay more attention to the various wearable devices, monitoring systems and bioelectronics that could significantly facilitate the day-to-day functions of athletes and their lives.

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