

Opioid Alternatives for Athletes
A Synthesis of the Research Literature

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Opioid Alternatives for Athletes: A Synthesis of the Research Literature

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Abstract

The purpose of this synthesis project is to investigate alternative approaches to opioids and their effectiveness for pain management. Research identified little levels of involvement by the athletic population in the use of opioid alternatives. The studies reviewed within the critical mass yield factors, which encouraged opioid alternative use and the benefits they have. Medical marijuana, physical therapy, and acupuncture resulted in the most popular opioid alternatives. Research in opioid alternatives has only begun from athletes with pain in regards to opioid alternatives. However there is uncertainty about opioid alternatives from athletes and medical staff. In the years to come, creating opportunities for opioid alternatives in athletics will be essential. Training for medical staff, coaches, athletes, and others about opioid alternatives will be essential as the window for alternatives widens in athletics. A recommendation is to provide these individuals with information in a minimum of a few key areas: the dangers of opioid misuse, the benefits of alternatives, and education about alternatives.

Keywords: opioid alternatives, medical marijuana, acupuncture, physical therapy

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Chapter 1 Introduction

According to the U.S. Centers for Disease Control (CDC, 2016), participation in organized sports is on the rise. Nearly 30 million children and adolescents participated in youth sports in the United States. This increase in play has led to an increase in injuries among young athletes. High school athletes accounted for an estimated 2 million injuries, 500,000 doctor visits, and 30,000 hospitalizations each year (Paterno, Taylor-Haas, Myer, & Hewett, 2013). In 2014, 1.35 million youths (ages 6-19 years) had a serious sports injury (USAToday, 2014). The most common diagnoses seen in emergency rooms (ERs) for sports injuries were strains or sprains, fractures, contusions and abrasions, concussions, lacerations, dislocations, and others. Strains or sprains accounted for 451,480 injuries, fractures 249,500, contusions 210,640, concussions 163,670, lacerations 85,560, dislocations 33,300, and other injuries 141,330.

In 2009, the top injuries in college football were concussions (7%), upper limbs (17%), torso and pelvis (12%), and lower limbs (50.4%). However ligament sprains were the most common injury, which accounted for thirty percent. In the same year men's college soccer, the top injuries were concussions (5.5%), head and face (4.3%), upper limb (6.2%), torso and pelvis (14.7%), lower limb (65.6%). Muscle strains were the most frequent injury among college soccer players (25.8%).

In 2013-2014, National Football League (NFL) athletes suffered a total of 1,300 on-field injuries (Cottler et al., 2014, updated from 2011). In a more recent report, concussions (244), ACL tears (56), and MCL tears (143) lead the way in NFL injuries (NFL, 2016). In the 2015-2016 National Basketball Association season, a total of 1094

players appeared in the injury database 3843 times (Drakos, Domb, Starkey, Callahan, & Allen, 2010). The two most common injuries were lateral ankle sprains (13.2%) and orthonormal inflammation (11.9%). In 2015, the leading injury cause for an athlete on the disabled list (DL) in the MLB was an elbow injury (Forbes, 2015). The leading injury in the NHL was concussions followed by upper and lower body injuries (Izralski, 2014).

There are many treatments available when it comes to sports injuries. Most sports injuries can be healed by following the acronyms RICE (Rest, Ice, Compression, and Elevation) and PRICE (Protect, Restrict, Ice, Compression, and Elevation) as well as with over the counter medication (e.g. Ibuprofen). However, different injuries require different rehabilitation treatments. Broken bones, muscle, and ligament tears are injuries that typically require surgery. If an injury requires surgery, it is important that the athlete start rehabilitation as soon as a doctor clears them (Kraemer, Denegar, & Flanagan, 2009). It is important that they rebuild the strength and flexibility they had prior to the injury. If a sport related injury does exist, the most pressing issue for the athlete is to get back on the field as quickly as possible (Wojtys, 2014). To help the athlete get back on the court or field, a prescription for opioids (e.g. OxyContin and Vicodine) could possibly be involved.

Opioids cause the brain's receptors to be flooded with a naturally occurring chemical called dopamine. As a result, pain signals are blocked, which creates a sense of calm. At first these drugs may be helpful in managing the pain, but athletes can quickly become dependent. Over time, opioids desensitize the brain's natural opioid system, making it less responsive. This creates tolerance, so the person will no longer respond to the current dose of the drug and will need a higher dose to achieve pain control (NIH,

2018). Tolerance fuels addiction because the athlete will need to continue to increase his dosage in order to experience the desired effect. These drugs, when taken in high doses, can have serious side effects, such as nausea, vomiting, seizures, and respiratory depression.

The number of prescriptions for opioids jumped from 76 million to approximately 207 million between 1991 and 2013 (NIH, 2014) and a startling half-million people have died since 2000 as a result of misusing painkillers (Bump, 2018). This issue especially impacts those who play sports. For example, former NFL players abuse opioid pain medications at four times the rate of the general population (Cottler et al., 2011). More than 50% of these users reported using opioids during their career, and more than 70% reported abuse of these drugs. Opioids have a negative impact not only on professional athletes but those in college and even in high school. At the college level, one study found that 62% of athletes used nonprescription medications for sports injuries, 12% took more than recommended, and 1.5% took medications for more than 10 days in a row (Khazzam, 2016). At the high school level, it was reported that 28.4% of athletes used medical opioids at least once over a three-year period (WV Board of Medicine, 2016). By the time high school athletes became seniors, male athletes had 2x the odds of being prescribed opioids during the past year and were 4x more likely to misuse opioids compared to males who did not participate in competitive sports (Veliz et al., 2014).

Reasons for Abuse

The use of opioids essentially changes the way a person can manage and deal with stress and pain. Opioids can cause the body to lose its natural ability to tolerate almost any discomfort or pain (American Academy of Pain Medicine, 2013). Some studies have

even shown that prolonged opioids use can reduce the body's natural pain fighting ability, causing someone who uses these drugs therapeutically to need them even more (American Academy of Pain Medicine, 2013). When an athlete suddenly loses access to opioids, it can cause them to feel pain more intensely. When an athlete who is dependent on opioids is given a regular dose of opioids to settle pain, it will make the drug feel ineffective to them because it is not providing enough of those feel good receptors in the brain. These receptors and chemicals are also part of temperament and emotional functions, often being negatively impacted by the extended use of these drugs. This makes opioid addiction much more powerful in many athletes, leaving them to feel ineffective by their own body functions.

Another factor that may lead athletes to abuse prescriptions are the intensity and competitiveness of athletics (Sack, 2012). At the college level, athletes report that the most pressing issue is to get back on the court or field (Khazzam, 2016). Consequently, many athletes will sacrifice their health and risk the negative side effects of substance use just to stay in the game (Sack, 2012). The culture of playing through pain only supports the approach of putting competition above all else. Athletes who play high contact sports are more likely to be exposed to norms surrounding risk taking, hiding pain, injuries, and putting winning above all. Athletes who take opioids do it to cover up injuries and may underreport pain and injuries to athletic trainers and doctors, and not allow their injuries adequate time to heal (Sack, 2012). Retired athletes may also turn to these drugs for pain relief due to previous injuries. For the athletes who are now retired and have misused opioids for years now claim to be paying the price. Many of them have reported the harmful consequences of using opioids such as chronic muscle problems, nerve

damage, and organ damage (Veliz et al., 2014). Many of them knew they were taking powerful addicting drugs but worried more about their careers.

Other factors that contribute to opioid abuse are ease of accessibility, frequency of prescriptions, and immediate satisfaction. Opioids are easily accessible through doctors, athletic trainers, family, and friends. Former Detroit Lions wide receiver Calvin Johnson was once quoted saying “team doctors pass out painkillers like candy during Halloween” (Long, 2016, p.126). Team doctors are essentially enabling athletes to become addicted. The convenience of opioid medications written has contributed significantly to the abuse problem. The widespread overprescribing of opioids has led to the abuse of these medications, and those who abuse opioids suffer the consequences (Brandt, 2018). The vast number of opioid prescriptions being written shows the wrong message to athletes about the dangers of opioid abuse. Not only has the number of opioid prescriptions nearly quadrupled since 1999, the average dose prescribed has risen dramatically (Brandt, 2018). In fact, the most destruction is seen in athletes who are taking these medications correctly. Sixty percent of deaths related to opioid use occur in those who were given a prescription based on physician guidelines, and the other 40% occur in people who get their opioids through diverted prescriptions or multiple prescriptions (Brandt, 2018).

Statement of Problem

Due to the widespread abuse and addiction of opioids in athletics, it is important that alternative solutions to pain management be investigated. By investigating the alternative methods to opioid use, the number of overdoses and misuses may be reduced.

The purpose of this synthesis project is to investigate alternative approaches to opioids and their effectiveness for pain management.

Operational Definitions

Opioids. According to the CDC (2017), opioids are prescribed by doctors to treat moderate to severe pain, but can also have serious risks and side effects. Common types are oxycodone (OxyContin), hydrocodone (Vicodin), and morphine.

Opioid alternatives. According to the CDC (2017), Opioid alternatives are non-pharmacologic therapies preferred for chronic pain.

Medical Marijuana. The NIDA (2018) defines it as using the whole unprocessed plant or the chemicals contained within it to alleviate the symptoms of certain conditions or diseases. A doctor prescribes medical marijuana.

Physical Therapy. Merriam-Webster (2016) defines physical therapy as, therapy for the preservation, enhancement, or restoration of movement and physical function impaired or threatened by disease, injury, or disability that utilizes therapeutic exercise, physical modalities (such as massage and electrotherapy).

Acupuncture. Merriam-Webster (2016) defines acupuncture as, an originally Chinese practice of inserting fine needles through the skin at specific points especially to cure disease or relieve pain.

Scope of Synthesis

Research for this synthesis will examine alternative approaches to pain management for athletes with sport related injuries. The research will focus on factors athletes perceive as having an impact on their experiences with opioid alternatives and how alternative methods affect their pain.

Chapter 2 Methods

Search Procedures

In order to find critical mass of articles on this topic, I used online databases SPORTDiscus, MEDLINE, CINAHL, ScienceDirect, and PubMed provided by Drake Memorial Library at the College of Brockport. Peer-reviewed articles related to opioid use in athletics, opioids in professional athletics, and alternative methods to opioids use were investigated and obtained. The first term used for a search, “Opioids in sports”, yielded a moderate range of articles receiving 287 hits. Searching the terms “opioid alternatives” received a wide range of articles receiving 1,599 results. In order to narrow down articles, the term “opioid alternative in sports” was used. Other terms searched on these databases included “opioids”, “opioids in professional sports”, “opioids in college and high school sports”, “major injuries in sports”, “medical marijuana in athletics”, “medical marijuana in the general public”, “acupuncture for sports injuries”, and “physical therapy for sports injuries”.

Criteria for Inclusion

The next step was to choose articles and studies to include in this synthesis. The inclusion criteria for articles were established to determine which studies to include from those found in the search. First, the studies selected consisted of those published between 2000-2018 in peer-reviewed journals. Next, each study chosen must address opioid use in sports and the alternative methods to combat opioid abuse in sports. In addition, the studies selected focused on athletes' experiences of using opioid alternatives, sports injuries, both men's and women's sports, and athlete's ages 15-50 years old. Finally, articles chosen included those which opioid alternatives were used from the point of view

of professional, college, and high school athletes and medical staff. Applying these criteria produced a critical mass of 17 articles.

Data Analysis

After the articles meeting the criteria were selected for this synthesis, an article grid was created to organize the materials. The grid offers a brief summary of the participants, methods, results, and discussions from each article. The findings in the body of research were compared, and various relationships appeared during the process, which were entered into a coding table (see Appendix B). The findings related to these relationships are discussed in the results section.

Chapter 3 Results

This section reviews the findings on alternatives to opioids for pain management. The findings are organized into the following themes: physical therapy, acupuncture, and medical marijuana. Many athletes will experience pain at some point in their career and it is important that they find a healthy alternative than addictive opioids. As you will find out there are several benefits to using opioid alternatives.

Physical Therapy

A physical therapist will develop a program that will help improve an athlete's function, range of motion, and level of pain. Common approaches that physical therapists will often use for pain management include electrical stimulation devices, cryotherapy, and cupping therapy. These are discussed next.

Electrical stimulation devices. Electrical stimulation devices send low voltage signals from a small device through pads attached to the skin. The signals disrupt the nerve signals to the brain or stimulate the production of epinephrine, the feel-good receptor, in the brain (Astokorki & Mauger, 2017; Blum et al., 2006). There are several different types of electrical stimulation devices. These devices include electrical muscle stimulation (EMS), H-Wave, TENS, and Biowave. All of these devices are used to help with acute and chronic pain (Astokorki & Mauger, 2017; Blum et al., 2006).

TENS is a non-invasive form of electrotherapy to treat pain. It interferes with pain receptors and prevents pain messages from reaching the brain. TENS has been shown to be helpful in reducing postoperative pain for athletes following surgery (Bjordal, Johnson, & Ljunggreen, 2003). H-Wave creates physiological changes while providing measurable benefits. H-wave helps with range of motion, blood flow, and other issues

that are associated with pain. As with the TENS device, the H-Wave also interferes with the pain receptors. Therefore the H-Wave has also shown to improve daily living, and opioid use has decreased (Blum et al., 2006). Other H-Wave studies show that 65% of 6,774 athletes had a reduced or elimination of pain and a reduction in painkillers (Blum et al., 2006).

Another electrical stimulation device used is Biowave. Like the H-Wave and TENS device, Biowave also is used to interfere with pain receptors. Biowave uses frequency conduction, to deliver high-frequency electrical signals through the skin into deep tissue. These signals travel to the surface of nerves encompassing the pain site. Biowave has also shown in athletes to reduce pain and improve exercise performance (Panchal & Pergolizzi, 2006). Biowave has become the most popular form of electrical stimulation device among college and professional athletes and athletic trainers.

Cryotherapy. Cryotherapy is another element associated with physical therapy. Cryotherapy is commonly used as a procedure to relieve pain symptoms, particularly in inflammatory injuries and overuse symptoms (Banfi, Lombardi, Colombini, & Melegati, 2010). Cryotherapy consists of exposing the athlete to very cold air that is maintained at -110°C to -140°C in special temperature-controlled cryo-chambers, generally for 2 minutes. Cryotherapy is used to relieve pain and inflammation. In sports medicine, cryotherapy is relatively new concept, but it is starting to gain wider acceptance as a method to improve recovery from injury. One study found that cryotherapy has shown to help with pain and inflammation (Abaidia et al., 2017).

Benefits also included improvement in pain, mood, and quality of life (Banfi, Lombardi, Colombini, & Melegati, 2010).

Cupping therapy. One of the oldest forms of physical therapy is cupping therapy. This therapy is over 2000 years old; however it is not very well known. Cupping therapy uses heating or pumping of glass or clay cups to create suction on the skin. There are two forms of cupping: “wet” and “dry”. Dry cupping relies on the suction, while wet cupping adds bloodletting to the process by lancing the skin. Due to the ban of opioids in the Olympics, this form of therapy has been really popular among its athletes (Peters, 2016). However, since cupping is not very well known, limited studies have been done. One study found that cupping therapy has shown to decrease the inflammation and stiffness in joints and muscles (Cao et al., 2014). It was also shown to speed up healing and remove pain and stress in the tissues. In another study, the effectiveness of cupping therapy on low back pain was examined (Sadek, 2016). Twenty soccer players with chronic lower back pain were divided into two groups: one that received cupping therapy and another that did not. The group that received cupping therapy showed significant improvements in lumbar spine flexion and extension. Although the research is limited, these studies suggest a potential positive short-term effect on cupping therapy on significantly reducing pain.

Acupuncture

Another alternative approach to pain management that has become popular among athletes is acupuncture. Acupuncture is when very thin needles are inserted at different places in the skin throughout the body to interrupt pain signals. Many athletes use acupuncture because it acts as a natural painkiller. When the needle is inserted the body

releases endorphins. When one uses acupuncture, inflammation decreases and range of motion increases. Acupuncture is shown to be an alternative for pain management with minimal side effects.

Multiple studies support the use of acupuncture as an alternative to pain management for different types of injuries. For example, acupuncture has been shown to significantly reduce pain levels in athletes with plantar fasciitis, a common overuse injury that creates micro-tears in the Achilles tendon (Thiagarajah, 2017). These benefits were noted between four and eight weeks of treatment, with no further significant reduction in pain beyond this duration. Another study examined the impact of acupuncture on four female athletes from the Great Britain National women's volleyball team complaining of shoulder pain (Osborne & Gatt, 2010). The results found that acupuncture had a short-term benefit in the athletes for reducing functional pain and increasing active range of motion.

In another study, amateur and professional athletes suffering from motor impairments due to head, neck, upper limb, and lower limb injuries received acupuncture (Ji, 2014). The researchers concluded that there was significant restoration of motility as a result of applying acupuncture. The total effective rate was calculated from a combination of patients in three categories: whole, operational, and improved. Athletes rated as whole had freer movements of the limbs without any limitations and were able to participate in normal physical training. Athletes in the operational category had complete resolution at the affected regions and movement was free and without limitation at lower levels of physically demanding activity. Improved patients had reduced pain levels and patients were able to perform simple exercises.

In addition to pain management from injury, acupuncture has also been found to reduce recovery following physical activity. Lin et al. (2011) investigated the effects of acupuncture on 24 male university basketball players who were divided into two groups, a control group and an acupuncture group. The athletes in the acupuncture group received acupuncture after they performed physical activity. Heart rate, lactic acid, and oxygen consumption were recorded at different exercise times. Lactic acid and oxygen consumption were measured after the conclusion of exercise to determine recovery. The results indicated that acupuncture could enhance an athlete's recovery ability.

Medical Marijuana

Medical marijuana uses the whole unprocessed marijuana plant or its basic extracts to aid in pain management. Medical marijuana can be smoked, vaporized, and eaten. In today's professional athletics it is illegal to consume any form of marijuana, whether it is medical or recreational. Medical marijuana has been shown to reduce pain in individuals and decrease the use of opioids (Lucas & Walsh, 2017). Whether the athlete has acute or chronic pain, medical marijuana can be an exceptional pain alternative method when compared to harmful opioids. Currently the NCAA, NFL, MLB, NBA, prohibit the use of marijuana. Consequently, there is no research available with the use of medical marijuana for pain management with athletes. Thus, the research presented focuses on the general public.

In a recent study, 37 patients with chronic pain who were taking multiple opioids took medical marijuana for one-year (Vigil et al., 2017). Patients reported they had pain reduction and an improvement in quality of life and social life. Medical marijuana also appeared to alleviate insomnia and may be helpful in relieving anxiety (Webb & Webb,

2014). In another study, the authors found that medical marijuana was an effective treatment with pain and mental health (Lucas & Walsh 2017). Medical marijuana has also shown to reduce the consumption of prescription opioids and the number of overdose deaths (Powell, Pacula, & Jacobson, 2015). Research suggests that medical marijuana is an extremely safe and effective medication for many patients with chronic pain. Side effects include dizziness or lightheadedness, dry mouth, fatigue, and muscle weakness (Grant, Atkinson, Gouaux, & Wilsey, 2012). Additionally, medical marijuana can prevent the development of tolerance to, and withdrawal from, opioids. These findings suggest that increasing safe access to medical marijuana may reduce the personal and social harms associated with addiction, particularly in relation to the pharmaceutical opioids (Lucas, 2017).

Summary

Physical therapy, acupuncture, and medical marijuana have shown to help combat opioid misuse among individuals. These opioid alternatives have also show to have several benefits associated with them. These benefits include decreased pain, increased blood flow, increased range of motion, and decreased prescription opioid use. There have been limited risks associated with each alternative. These risks have included soreness, fatigue, and bruising. By using opioid alternatives, individuals can lead a safer and healthier life.

Chapter 4 Discussion

Research suggests that opioid alternatives can be viable option for providing pain management to athletes with minimal side effects. While there is evidence of attempts to increase opioid alternative methods, there lacks extensive research on specifics that would help medical staff, coaches, parents, and athletes provide more information for alternatives to opioids in athletics. If decreasing opioids in athletics is the goal, certain ideas need to be put into place in order to successfully accomplish it. This includes providing more education and awareness about opioid alternatives and opioid misuse for all individuals involved in athletics as well as recommendations for the athletic community regarding opioid alternatives.

Education and Awareness

Currently there is not much education out there concerning opioid alternatives. Most of the current education deals with testimonies and statistics from athletes and medical staff that opioid alternatives work. The current education deals with the simple and popular alternatives to pain management, such as rest, ice, and other less addicting pain medications like Tylenol and Advil.

Opioid alternatives are lacking due to a shortage of therapies and limited access to available resources (Kamal, 2018). Medical personnel have few treatments at their disposal for treating pain, and athletes often expect to be prescribed opioids. It is important that medical personnel strive to improve alternatives for pain management for all athletes (Kamal, 2018). Physical therapy, electrical stimulation, and cognitive behavioral therapies are all proven to help athletes with pain but are less accessible than opioids due to financial difficulties (Kamal, 2018). Medical marijuana is another

alternative to opioids that is growing in popularity and deserves consideration by physicians, medical personal, parents, and athletes. Medical marijuana can both control pain signals and improve psychological factors associated with pain (Watt-Watson et al., 2009).

There is also a clear need for education on the knowledge and the use of medical marijuana. Greater educational opportunities relating to medical marijuana should be made available to improve care and to provide greater treatment options for athletes (Thiessen, Matthews, & Walsh, 2017). Medical marijuana must be subject to the same benefits as other medications, and an important aspect of that is proper training for healthcare professionals.

Education on opioid alternatives has to start at the top with medical personal. Doctors and athletic trainers currently receive limited to no education on alternatives. A 2009 survey of medical school curriculum found that on average only 16 hours were spent on pain education over the entire duration of the program (Watt-Watson et al., 2009). The same study found veterinarians receive more pain education than medical students, receiving an average of 87 hours of pain education. In addition, the National Athletic Trainers Association (NATA) currently doesn't cover opioid alternatives in their curriculum (National Athletic Trainers Association, 2016). However there are seminars and conferences that are sponsored by the NATA that speak about the alternatives to pain.

Athletic trainers normally see athletes on a more regular basis and it may be easier for them to recognize when an athlete is not his or herself. When it comes to education and awareness on opioid misuse, athletic trainers should focus on three things (Ford,

2008). First, monitor athletes who are considered at-risk athletes. Athletes with previous injuries or lingering injuries are more likely to misuse and abuse drugs than the average athlete. Second, athletic trainers should monitor athletes to understand their motives for misusing and abusing opioids. Athlete's misuse or abuse opioids for two different reasons: (1) using the medication beyond their assigned dosage and (2) the sensation of feeling high (Boyd, Young, & McCabe, 2014). Third, know the signs and symptoms of opioid misuse or abuse. If athletic trainers can identify high-risk athletes and their reasons for using opioids, then they may be able to prevent further misuse, abuse, or addiction (Knopf, 2016).

With the proper education and awareness, athletic trainers can make a positive impact on the fight against opioid abuse in the athletic population (Knopf, 2016). Athletic trainers also need to be able to communicate effectively with team doctors, coaches, and parents to get the athlete the help they need. With the help of the athletic medical personnel, we may see opioid misuse and abuse decrease in athletics.

Coaches, teachers, and parents can also play a role in keeping athletes safe from the consequences of opioid use. The first is to encourage athletes to rest, heal, and rehabilitate before returning to play. Early return to play can be linked to repeat injury, as well as injuries to other parts of the body. Athletes should not be pressured to return to play too soon, as they may seek pain medications to play through the pain. As an administrator or parent, it is important to know the signs of opioid misuse and withdrawal. Signs of opioid misuse include dilated pupils, redness of the face and neck, and slurred speech. Signs of withdrawal include big pupils, loss of appetite, insomnia, and frequent trips to the bathroom (CDC, 2018). Those athletes who misuse opioids will

also have behavior changes. An example of this is when an athlete may unexpectedly go from ecstasy to hostility. They also may experience depression, anxiety, or a decrease interest in activities (Veliz, 2015). It is important to talk to athletes about their injury and treatment, as well as to encourage them to talk to their physician about alternatives to opioids. Given the high abuse potential, parents should supervise opioid medication use. Coaches, teachers, parents, and athletic trainers should work together to educate, prevent, and identify those who misuse opioid medications.

Recommendations

If the CDC increases opportunities for opioid alternatives, there will be a need to offer more information to the individuals that will be responsible for assisting and using these opioid alternative methods in athletics. There will need to be training in place that would offer all involved information about opioid alternatives and inform them about the types of benefits they have. Training in these areas should increase the success and safety of opioid alternatives in professional, college, and high school athletics. The National Federation of High School Associations, National Collegiate Player Association, and National Football League Players Association are organizations that should provide trainings for athletes in opioid awareness as these organizations are also responsible for concussion and hazing awareness. In the future, it will be important to educate athletes, coaches, athletic directors, parents, and medical staff about opioid alternatives. A recommendation is to provide information in a few key areas: appropriate pain management techniques, benefits and risks of use, and education about different types of alternatives. Teaching this information to already existing techniques used and ensuring

that coaches, athletes, parents, athletic directors, and medical staff are using these techniques will help to improve the physical and mental health and decrease overdoses.

Limitations and Future Research

There are several limitations regarding the topic of opioid alternatives in athletics. Most of the research done on this topic is only about a decade old; thus, continued research on these alternatives and any new methods is needed. More research is also needed across all levels of athletics: professional, college, and high school. Each alternative method may have different effects depending on the age and development of the athlete. Some alternative methods have not been examined in athletic populations due to legal reasons (i.e., medical marijuana). Given the increase in legalization of medical marijuana in the United States, it may be a potential option in the future for athletes. Thus, research concerning medical marijuana as a treatment for pain management in athletes is warranted. Other limitations include inaccurate and/or incomplete survey responses and low response rates.

Conclusion

In the years to come, using opioid alternatives in high school, college, and professional sports will be essential. These alternative methods need to be used earlier and more often for pain management to reduce or prevent the potential for addiction to opioids. Medical personnel, coaches, parents, and others will be responsible for ensuring that there are opportunities in place for athletes to be given the chance to use opioid alternatives. However, there still remains a need for widespread research to be completed on opioid alternatives in athletics. As these opportunities improve, it will be essential that everyone involved in athletics are educated on how to use opioid alternatives. It is

important that these opioid alternatives are used to ensure positive experiences and improve the physical and mental health for all athletes.

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Appendix A

Article Grid

Author	Title	Source	Purpose	Methods & Procedures	Analysis	Findings	Recommendations
Abaïdia, A., Lamblin, J., Delecroix, B., Leduc, C., McCall, A., Nédélec, M., Dupont, G.(2017)	Recovery From Exercise-Induced Muscle Damage: Cold-Water Immersion Versus Whole-Body Cryotherapy	International Journal of Sports Physiology and Performance	This study compares the effects of cold-water immersion (CWI) and whole-body cryotherapy (WBC) on recovery kinetics after exercise-induced muscle damage	This study uses ten physically active men performed single-leg hamstring eccentric exercise comprising 5 sets of 15 repetitions.	Study of participants through comparative methods of CWI and WBC	Concluded that soreness was moderately lower. CWI was more effective than WBC in accelerating recovery kinetics for countermovement-jump performance at 72 h post exercise. CWI also demonstrated lower soreness and higher perceived recovery levels across 24-48 h post exercise.	The study had a limited sample size, but the results were consistent throughout the study. With this being a new form of therapy more studies will need to be conducted so all results are consistent.
Astokorki, A. H. Y., &	Transcutaneous electrical nerve stimulation	European Journal of	This study sought to ascertain	In two parts, 18 (Part I) and 22 (Part	The results of the study were to	These findings demonstrate that TENS can	The study had a limited sample size of

Mauger, A. R.(2017)	reduces exercise-induced perceived pain and improves endurance exercise performance	Applied Physiology	whether TENS and IFC could reduce exercise-induced pain (EIP) and whether this would affect exercise performance.	II) healthy male and female participants completed an isometric contraction of the dominant bicep until exhaustion (Part I) and a 16.1 km cycling time trial as quickly as they could (Part II) whilst receiving TENS.	compare and contrast the effectiveness of TENS device.	attenuate perceived EIP in a healthy population and that doing so significantly improves endurance performance in both submaximal isometric single limb exercise and whole-body dynamic exercise.	participants, but the TENS device was show to improved performance. Future research will be needed in order to get consistent results. Also a study should be done separating men and women's to see if the results were also. consistent.
Banfi, Lombardi, Colombini, & Melegati (2010)	Whole- Body Cryotherapy in Athletes	Sports Medicine	To determine if Whole Body cryotherapy enhances recovery from injuries and possible modification of physiological parameters, taking into consideration	From 30 rugby players who underwent WBC treatment, 10 athletes from the Italian national team were randomly selected to	This study compared previous studies in order to establish a common relationship. To see the effects WBC have on the body	In conclusion: WBC has no detrimental effect on immunological parameters. WBC has an immunostimulating effect.	Further studies are necessary to confirm the present observations. Standardization of exposure times and the number of treatments during each cycle could improve data comparison.

			the limits imposed by antidoping rules, is crucial for athletes and sports physicians for judging the real benefits	be studied before and after a WBC treatment cycle performed at Spala, Poland. The treatment was applied once a day for 5 days; during this period, the athletes trained regularly and following the same protocol used during the previous weeks.		WBC induces an increase in anti-inflammatory WBC is a procedure that facilitates athletic recovery.	Intensities and frequencies of treatments are quite similar in the different studies, but a specific effort to standardize protocols in patients with various pathologies, and especially in athletes, should be encouraged
Bjordal, Johnson, & Ljunggreen (2003)	Transcutaneous electrical nerve stimulation (TENS) can reduce postoperative analgesic consumption. A	<i>European Journal of Pain,</i>	To find out if transcutaneous electrical nerve stimulation (TENS) or acupuncture-like transcutaneous	Current intensity: "strong, definite, subnoxious, maximal tolerable" or above	Investigate the results from previous literature to examine if TENS reduced	TENS, administered with a strong, subnoxious intensity at an adequate frequency in the wound area, can	Though TENS device can reduce postoperative pain, more research will need to be done in order to draw more accurate

	meta-analysis with assessment of optimal treatment parameters for postoperative pain		electrical nerve stimulation (ALTENS) can reduce analgesic consumption after surgery	15mA, and electrode placement in the incision area) were performed Eleven of the trials compromising 964 patients, had reports which stated that a strong, subnoxious electrical stimulation with adequate frequency was administered	postoperative pain.	significantly reduce analgesic consumption for postoperative pain.	conclusions. A bigger sample size will be needed.
Blum, K., Chen, T. J., Martinez-Pons, M., Dinubile, N. A., Waite, R. L., Schoolfield,	The H-Wave small muscle fiber stimulator, a nonpharmacologic alternative for the treatment of chronic soft-tissue injury and	PubMed	This study examines the H-Wave small-muscle fiber stimulator significantly reduced chronic pain and restored	Cross sectional, computer-administered 10-item survey was administered to 6774 patients	This study compared previous studies in order to establish a common relationship and theme.	Sixty-five percent of study participants reported a reduced or eliminated need for pain medication.	This study was one of the largest outcome studies on the benefits of the H-Wave device in patients with chronic soft-tissue injury or neuropathic pain.

J., Meshkin, B (2006)	neuropathic pain: An extended population observational study		physical function among patients with pain in the lower and upper extremities and spine	(3367 men [49.7%], 3406 women [50.3%], and 1 sex not reported [$<1\%$]; mean \pm -SD age, 45.28 \pm -10.08 y; range, 18-65 y) with chronic soft-tissue injury or neuropathic pain to assess their therapeutic response.		The results suggest that this nonpharmacologic approach may provide an important alternative to standard pharmacologic treatment.	The results were consistent to previous studies.
Cao,H., Li,X., Yan, X., Wang,N.S., Bensousann, A., Liu, J (2014)	Cupping therapy for acute and chronic pain management: A systematic review of randomized clinical trials	ScienceDirect	The purpose of this study was to assess the effectiveness and safety of cupping for different types of pain.	Thirteen databases and four trial registries were searched for randomized clinical trials. Meta-analysis of data was conducted if	Results from other single studies showed significant benefit of cupping compared with conventional drugs or usual care.	This review suggests a <u>potential positive</u> short-term effect of cupping therapy on reducing pain intensity.	However, the limited number of trials deterred from conducting subgroup analyses.

				<p>there was non-significant clinical and statistical heterogeneity. Sixteen trials with 921 participants were eligible and included. Six trials were assessed as low risk of bias, another six trials were of unclear risk of bias, and the remaining four trials were of high risk of bias.</p>	<p>Hematoma and pain at the treated site, increasing local pain or tingling were reported as mild adverse effects of cupping.</p>		
<p>Grant, I., Atkinson, J. H., Gouaux, B., & Wilsey, B.(2012)</p>	<p>Medical Marijuana: Clearing Away the Smoke</p>	<p>The Open Neurology Journal</p>	<p>This article review evidence that cannabis may be useful as medicine. It discuss potential</p>	<p>Interview Methods were used for individuals to describe their</p>	<p>As with all medications, benefits and risks need to be weighed in recommendin</p>	<p>Increasing anecdotal and clinical study reports of potential benefit, advances in understanding of</p>	<p>Well as growing public acceptance that cannabis should be available as a medicine if a</p>

			indications for its use and provide an algorithm to guide medicinal cannabis recommendations	experience with medical marijuana	g cannabis to patients. An algorithm that may be useful to physicians in determining whether cannabis might be recommended as a treatment	the endocannabinoid signaling system upon which cannabis acts	physician recommends it
Ji, H(2014)	Traditional Chinese Medicine Acupuncture and Clinical Research for the Treatment of Motility Limited Physical Activity	Bulletin of Science and Technology	Researchers from the Physical Education Institute at Zhengzhou University investigated the effects of Traditional Chinese Medicine (TCM) style acupuncture and herbs on amateur and professional athletes suffering from	Participants in the study suffered from physical motility limitations. Head and neck impairments accounted for 42% of the patients. Upper limb impairments comprised 24.6% and lower limb impairments	The total effective rate was calculated from a combination of patients in three categories of improvement : cured, effective, and improved.	The researchers concluded that restoration of motility is significant as a result of applying acupuncture	The results indicate that athletes understand the benefits of acupuncture.

			motor impairments due to the demands of physical training.	accounted for 85.4% of participants. Acute physical limitations accounted for 85.4% of participants and 14.6% were patients with chronic motility impairments.			
Lin, Chen, Fan, Wu,, Lan.,& Lin. (2011).	Effects of Auricular Acupuncture on Heart Rate, Oxygen Consumption and Blood Lactic Acid for Elite Basketball Athletes	<i>The American Journal of Chinese Medicine</i>	This study investigated the effects of auricular acupuncture on athletes' recovery abilities after exercise.	Subjects were selected from twenty-four male elite university basketball players, randomly divided into two groups: auricular acupuncture group (AAG), and normal control	Analysis of data to see if acupuncture after exercise worked. They examined elite basketball athletes who used acupuncture after exercise in a clinical setting.	This suggests that auricular acupuncture can enhance athletes' recovery abilities after aggressive exercise.	Due to the limited sample size, more research will need to be done in order to replicate the results. Also a larger sample size should also be included. 24 athletes is too small of a sample size.

				group (NCG), each group containing twelve subjects. Auricular acupuncture was experimented to each AAG athlete while no auricular acupuncture was conducted to each NCG athlete. Each subject in both groups performed a ride on the stationary bike until exhausted			
Lucas, P.(2012)	Cannabis as an Adjunct to or Substitute for Opiates in the Treatment of Chronic Pain	Journal of Psychoactive Drugs	There is a growing body of evidence to support the use of medical cannabis as an	Interview Methods were used for individuals to describe	Analysis using the pro medical marijuana framework, examined	Additionally, cannabinoids can prevent the development of tolerance to and	Despite a lack of regulatory oversight by federal, community-based medical cannabis

			adjunct to or substitute for prescription opiates in the treatment of chronic pain	their experience with medical marijuana	patients who use medical marijuana in a clinical setting.	withdrawal from opiates	dispensaries have proven successful at supplying patients with a safe source of cannabis, and may be reducing the problematic use of pharmaceutical opiates and other potentially harmful substances in their communities.
Lucas, P., & Walsh, Z (2017)	Medical cannabis access, use, and substitution for prescription opioids and other substances: A survey of authorized medical cannabis patients	International Journal Of Drug Policy	Analyzes and explore the use of medical marijuana as a healthy alternative to opioids	Online survey consisting of 107 questions on demographics, patterns of use, and cannabis substitution effect. The survey was completed by 271 respondents.	The results of the survey were compiled and compared and contrasted to understand the use	Cannabis is perceived to be an effective treatment for diverse conditions, with pain and mental health the most prominent.	The finding that patients report its use as a substitute for prescription drugs supports prior research on medical cannabis users; however, this study is the first to specify the classes of prescription drugs for which cannabis it is used as a substitute.

Osborne NJ, Gatt IT(2010)	Management of shoulder injuries using dry needling in elite volleyball players	Acupuncture in Medicine	Describe the short-term benefits of dry needling in shoulder injuries in four international female volleyball athletes during a month-long intense competitive phase	Range of movement, strength and pain were assessed before and after treatment, with a functional assessment of pain immediately after playing and overhead activity, using the short form McGill Pain Questionnaire	Analysis of using the McGill pain questionnaire to understand the benefits of acupuncture	Support the use of dry needling in elite athletes during a competitive phase with short-term pain relief and improved function in shoulder injuries	This study had a limited number of participants(4), but the results were similar to other acupuncture studies.
Panchal, S. J., & Pergolizzi, J(2006)	Biowave White Paper on Use of a Neuromodulation Pain Device to treat Acute Sports Injuries	Clinical study by Biowave	Various treatment algorithms for the management of nonmalignant pain have been proposed which include a stepwise	Any football player in training camp and active and practice squad members during the playing	Data analysis during collection, after being transcribed athletes who had common experiences.	In regard to patient global impression, the majority of subjects would request the Biowave PRO treatment with a perceived superiority in	This is the first study of the use of the Biowave PRO device to treat the pain associated with sports-related injuries.

			<p>approach at managing pain with emphasis on utilizing the least invasive strategies whenever feasible</p>	<p>season who were injured were eligible to participate. Treatment would be offered on a daily basis until the condition resolved, or until the subject was no longer able to participate</p>		<p>comparison to other electro-therapy devices they had used</p> <p>The subjects expressed great satisfaction with the treatments, and requested repeat treatments</p>	<p>Future studies to be performed in professional basketball and baseball players will give needed additional information.</p>
<p>Powell, D., Pacula, R. L., & Jacobson, M(2015)</p>	<p>Do medical marijuana laws reduce addictions and deaths related to pain killers?</p>	<p>Science Direct</p>	<p>The purpose to find that medical marijuana laws reduce the daily doses filled for opioids</p>	<p>We replicate the result for opioid overdose deaths and explore the potential mechanism. The key feature of a medical marijuana law that facilitates a reduction in overdose</p>	<p>Analyzing the data collected, to determine if states with medical marijuana laws have a reduce in opioid related deaths</p>	<p>These findings suggest that broader access to medical marijuana facilitates substitution of marijuana for powerful and addictive opioids.</p>	<p>With more access to medical marijuana dispensaries, less addictive opioid prescriptions will be used.</p>

				death rates is a relatively liberal allowance for dispensaries.			
Sadek (2016)	Effects Of Cupping Therapy Based On Stabilization Core Exercises On Low Back Pain For Soccer Players In State Of United Arab Emirates.	Science, Movement and Health	The aim of this study was to determine effectiveness of cupping therapy on low back pain for soccer players in state of United Arab Emirates	Twenty athletes. Recruited for the study were between the ages of 22 and 25 years old, with a mean age of 24 years. Divided into two groups, experimental group consisted of (10) soccer players. Control group consisted of (10) soccer players. All two groups had chronic low back	Data analyses during collection examine the effects cupping therapy on soccer players who experienced lower back pain. Post measurements were taken to see the effect cupping had on lower back pain.	The experimental group showed improvement increase in lumbar spine flexion and extension but not significant between the pre and Post measurement Cupping Therapy can be used to recovery from sports injury.	More research on cupping therapy will be needed, as the sample size was small. This study was very specific to lower back pain; a study looking at another injury might draw a larger sample size.

				pain. Cupping Therapy were one- week period for experimental group. Two days weekly.			
Thiagarajah, (2017)	How effective is acupuncture for reducing pain due to plantar fasciitis?	Singapore Medical Journal	To determine the effectiveness of acupuncture in reducing pain caused by plantar fasciitis.	Randomized controlled trials and that compared acupuncture with standard treatments or had real versus sham acupuncture arms were selected	Data analysis during collection found common relationships between athletes	These showed that acupuncture significantly reduced pain levels in patients with plantar fasciitis Side effects were found to be minimal	Further research is required to strengthen the acceptance of acupuncture among healthcare providers.
Vigil, J. M., Stith, S. S., Adams, I. M., & Reeve, A. P(2017)	Associations between medical cannabis and prescription opioid use in chronic pain patients: A	PubMed	Study was used to examine the association between enrollment in the New Mexico	Thirty-seven habitual opioid using, chronic pain patients (mean age = 54 years;	Surveys were compare in order to establish common themes and responses	Survey responses indicated improvements in pain reduction, quality of life, social life, activity levels,	Further investigations on cannabis as a potential alternative to prescription opioids for

	preliminary cohort study		Medical Cannabis Program (MCP) and opioid prescription use.	54% male; 86% chronic back pain) enrolled in the MCP between 4/1/2010 and 10/3/2015 were compared to 29 non-enrolled patients (mean age = 60 years; 69% male; 100% chronic back pain).		and concentration, and few side effects from using cannabis one year after enrollment in the MCP	treating chronic pain.
Webb, C. W., & Webb, S. M(2014)	Therapeutic Benefits of Cannabis: A Patient Survey	Hawai'i Journal of Medicine & Public Health	To discover the benefits and adverse effects perceived by medical cannabis patients, especially with regards to chronic pain	Surveys to one hundred consecutive patients who were returning for yearly re-certification for medical cannabis use in Hawai'i	Surveys compared common relationships	These results suggest that Cannabis is an extremely safe and effective medication for many chronic pain patients. Cannabis appears to alleviate pain, insomnia, and may be helpful in relieving anxiety	Cannabis has shown extreme promise in the treatment of numerous medical problems and deserves to be released from the current Schedule I federal prohibition against research.

Appendix B
Coding Table

Types of Content	Study Starts with	Summary and Keywords	Sources
Physical Therapy	Opioid Alternative	Electrical Stimulation for pain management	Astokorki & Mauger, 2017; Blum et al., 2006, Bjordal, Johnson, & Ljunggreen, 2003, Panchal & Pergolizzi, 2006
Physical Therapy	Opioid Alternative	Cupping Therapy	Peters, 2016, Cao et al., 2014, Sadek, 2016
Physical Therapy	Opioid Alternative	Cyrotherapy	Banfi, Lombardi, Colombini, & Melegati, 2010, Abaidia et al., 2017
Acupuncture	Opioid Alternative	Benefits of Acupuncture over opioids	Thiagarajah, 2017, Osborne & Gatt, 2010, Ji, 2014, Lin et al., 2011

Medical Marijuana	Opioid Alternative	Benefits of medical marijuana	Lucas & Walsh, 2017, Vigil et al., 2017, Powell, Pacula, & Jacobson, 2015, Grant, Atkinson, Gouaux, & Wilsey, 2012
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