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Does Technology Have a Relationship in the Number of Injuries Within Youth Sport?

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Over the past 10-15 years, there has been quite an increase in the occurrence of injuries among youth and amateur athletes. Shoulder and elbow injuries have been exponentially growing in baseball and softball players. While anterior cruciate ligament or ACL injuries have increased drastically in a wide range of sports. With those being the most popular injuries, there are numerous other examples all across youth sports.

These injuries fall into two different categories, contact and non-contact injuries. Contact injuries are of course, injuries from contact. When people think of contact injuries, concussions, broken bones, bruises, and other injuries come to mind. Concussions in football especially have come under the serious spotlight in the past decade with more data coming out about CTE and head injuries, more are being educated about the topic.

Non-contact injuries are of course injuries that happen without contact. Common non-contact injuries include ACL tears, throwing arm injuries in baseball and softball players, and more. Some of these throwing arm injuries can result in months long recoveries. Non contact injuries can also have lifelong implications.

This incline in youth sports injuries could scare parents and kids away from sports. In fact, there are many parents who keep their kids away from playing football all together due to concerns about concussions and permanent brain damage. Some schools even restrict tackle football from being played until high school. With the technological advances our world has made during the same time period, there have to be ways to prevent all these injuries in young athletes. The purpose of this study will be done in order to discover whether or not technology has a relationship with the number of injuries in youth sports.

Literature Review

Technology

The first part of the conversation about technology and whether or not it is related to injury within youth sport comes about the different types of injury prevention methods. Within this portion, there will be 6 different methods discussed. Those six different methods are kinesiotaping, heart rate monitoring devices, accelerometers/gyroscopes, dynamometry, camera-based monitoring systems, and inertial sensor monitoring units.

The first method to talk about is kinesiotaping which is the use of elastic, quick-drying tape to help manage pain and dysfunction for athletes. Kinesiotaping is a technology that came into existence in the 1970's but has become much more popular in the 2000's. This method helps with injury prevention in the way that when it is applied the blood flow is increased to the area that is taped over, improves mechanical stabilization, and will improve kinesthesia.

In the terms of subacromial impingement or also known as swimmer shoulder, which causes pain in the shoulder and restricts the full motion of the shoulder. Kinesiotaping has been seen to have positive effects on those that suffer from swimmer's shoulder (Vellios, 2020). Further studies along this type of injury prevention include that of using the tape for a longer period of time and even then going through clinical treatment to narrow down on how to best use kinesiotaping.

The next method to talk about is a heart rate monitoring device. These technologies can capture both real-time heart rates and also provide analytic data on net heart rate, heart rate variability, and heart rate trends (Vellios, 2020). Heart rate monitoring devices can come at a relatively low cost and are great for getting certain information. This is an important piece of

technology because everyone has varying heart rates when it comes to performing, and being able to track everyone individually is important.

This type of technology can come in various forms from Apple watches, Fitbits, Suunto Ambit3, and Zoom HRV. It is important to use these because they will track in real-time and then can provide data on target heart rate, trends, and the variability of your heart rate while performing (Vellios, 2020). Heart rate monitors can also track the different levels of performance that you will be doing. They are able to track through frequency, intensity, and even the duration of the activity.

The next method is accelerometer/gyroscopes specific applications for the prevention of shoulder and elbow injuries in the overhead athlete include using accelerometers and gyroscopes to measure and analyze body motion, elbow torque, and arm position. Prior to these types of technology, the only technology that was there to help with learning how athletes will move and can move was the pedometer (Vellios, 2020). The accelerometer/gyroscopes were made to help benefit athletes in more ways than just tracking motion, they also benefit in monitoring sleep duration and levels of sleep. They have been used on athletes in sports including swimming, ice hockey, American football, basketball, rugby, baseball, and badminton. There are many variations of devices which include the Apple Watch, Fitbit, Microsoft band, and Nike+ FuelBand(Vellios, 2020).

Next is dynamometry, which talks about how they are used by athletic trainers in the sense of quantifying muscle force (Vellios, 2020). For athletes injuries regarding the shoulders have become more evident over the past years. For dynamometers, there are two main forms which are the hand-held dynamometry (HHD) and the fixed frame system.

HHD's are hand-held force sensors that can be worn or held where the user can exert an amount of force onto the tester to be able to measure the amount of force that is being produced by a certain muscle group. This is a great form of injury prevention in the sense that they are extremely portable, user-friendly, and will be cheaper than other isokinetic measuring tools. HHD in professional baseball pitchers has shown decreased preseason external rotation (Vellios, 2020).

Fixed frame dynamometry has been used as an alternative to HHD in order to expand its applications to larger lower extremity muscle groups (Vellios, 2020). Fixed frameworks in the way that the user will apply force to the frame allowing the device to be able to record the force output in real-time using a variety of conditions. These devices come with complex proprietary algorithms that use the data provided by the patient in order to create individualized training regimens (Vellios, 2020). The National Football League (NFL) has begun to use these portable fixed-frame and platform systems for pre-season screening, in-season training, post-injury/surgery rehabilitation, and weekly performance testing (Vellios, 2020).

The next method is camera-based monitoring systems which talk about how the new tech in this sense has been able to pinpoint and explain better how an athlete might have gotten injured. This type of technology has been effective in being able to showcase when and how athletes in baseball, tennis, and water polo have gotten injured. Within those same sports, this technology has been able to prevent injuries from happening.

Lastly, there are the inertial sensor monitoring units (IMU) which talk about how they are small portable microelectromechanical systems attached to a patient's body and used to track limb and/or trunk motion over the duration of a certain activity (Vellios, 2020). IMU's are popularly used in baseball and other throwing sports in such ways that they help to quantify

throwing workloads to prevent overuse. A study that was done by Leafband et al. was using the MotusBASEBALL sleeve, this is an IMU, showing that increased ball velocity does not necessarily mean increased elbow torque. The study essentially demonstrated that doing long toss can and will help increase shoulder strength and range of motion for athletes in baseball. The availability, affordability, and ease of use have allowed IMU's to become a prominent component of sports performance monitoring in the overhead athlete at the high school, collegiate, and professional levels (Vellios, 2020).

Contact Injuries

With contact sports, it has been proven time and time again in many studies that concussions are the most common injuries. A study from the CDC showed that a staggering 2.5 million high school students who either play sports or are physically active reported having at least one concussion in the past year, 15.1% of high school students that voluntarily took a survey (DePadilla et al, 2017). This was down a couple of percent from studies from previous years as numbers ranged from 17.6% to 20.1% (DePadilla et al, 2017). Of course, this is hard to put a lot of weight into due to it being a voluntary survey and athletes not being too sure if they had a concussion in the first place. This contradicts a book chapter we looked at that said concussions for ages 10-19 have risen 71% from 2010 to 2015 (Peachman et al, 2022). While this is not the exact age group we are looking at, it still provides a good baseline to see if injuries are indeed going down. Despite what it looks like, the authors of the book say a rise in concussions may potentially not be the worst thing. A rise may not necessarily mean that there are more concussions, but simply more people are being educated about concussions and the protocol surrounding them. A study also reported that 40% of athletes said their coaches had no idea their athletes even had symptoms in the first place (DePadilla et al, 2017).

As many may be able to guess, football is the sport most responsible for all these concussions among young male athletes and soccer was the sport most responsible for concussions among female athletes (Sarmiento et al, 2019). In the seven-year period of a study, football accounted for 52,088 emergency department visits for traumatic brain injuries, which was 26.8% of all visits (Sarmiento et al, 2019). Soccer contributed to 13.1% of traumatic brain injury visits to the emergency department during this time for females and playground incidents contributed to 12.6% for females (Sarmiento et al, 2019). The study also found that males had nearly twice as many visits to the emergency department than females and the risk for these visits increased with age (Sarmiento et al, 2019). Contact sports resulted in twice as many traumatic brain injury visits than non-contact sports (Sarmiento et al, 2019).

Non Contact Injuries

One of the most common injuries that we are seeing growth in youth sports is ACL injuries. Noncontact knee injury rates are alarmingly high and represent a significant concern in many pivoting sports such as basketball. Severe knee injuries, such as ACL injuries, not only cause a long absence from the sport that the player is participating in but also can bring on some devastating future health problems. Youth athletes that run into these noncontact knee injuries, later on, could run into early posttraumatic osteoarthritis. Post-traumatic arthritis is inflammation in your joints that forms after you've experienced trauma (Cleveland Clinic, 2021). Posttraumatic OA develops after any type of joint injury. Injury may be in the form of fracture, cartilage damage, acute ligament sprain, chronic ligamentous instability, or even a combination of these (Thomas et al, 2017). In high school sports specifically, a lot of these noncontact knee injuries seem to occur. Knee injuries account for 15% of all high school sports-related injuries. Among knee injuries, 23% involve the meniscus and 25% involve the ACL, with isolated

injuries to the meniscus accounting for 11% and the ACL, 12% of all knee injuries (Thomas et al, 2017). In the United States alone we are seeing over 250,000 ACL injuries, of which 175,000 involve the reconstruction of that ligament (Thomas et al, 2017).

Ankle injuries are also very common when it comes to noncontact injuries. Rolling your ankle could legitimately happen at any time doing any sport-related task. These ankle injuries are also a contributor to Posttraumatic OA. Ankle injuries are common and account for roughly 20% of all emergency department visits each year and 23% of all high school sports-related injuries. Of these injuries 85% are lateral ankle sprains, However, 37% of all cases of ankle PTOA are the result of fractures (Thomas et al, 2017). Something that we tend to see in ankle injuries is that they are more likely to reoccur than say an ACL injury. Athletes that have a history of ankle sprains, frequently develop lifelong symptoms, recurrent injury, and disability after an ankle sprain. In fact, 75% of individuals with a history of an ankle sprain may have chronic ankle instability (CAI) (Thomas et al, 2017).

With all these injuries taking place in youth and amateur sports, what are we doing from a technological standpoint or lack of to prevent and cause these injuries? A study done by the Samford University's women's soccer program and Champion Sports Medicine has shown that technology and prevention can make a difference in the health of athletes. Their goal was to design a wearable technology that allowed them to prevent injury in their women's soccer players. Each member of the team wore A 3D wearable sensor technology, entitled ViPerform AM. ViPerform is a wireless sensor technology that tracks and measures how elite athletes move in real time. The ViPerform system consists of wearable motion and muscle activity sensors that record data at 200 frames per second, and intuitive software with sophisticated algorithms that turn robust data into easy-to-read and meaningful results (SportsMD, 2018). This is supposed to

help coaches and trainers evaluate and screen their players during the season. They also implemented the ACL Play-IT-Safe program, a multicomponent training program that incorporates movements emphasizing strength, coordination, balance, flexibility, and plyometrics (SportsMD, 2018).

The only issue with the VIPerform system for youth athletes is that it is going to be very hard to afford these systems for all youth athletes across the world. As it was shown to be very helpful for the Samford soccer team, ultimately would every youth athlete be able to get their hands on this technology. The Play-IT-Safe program on the other hand could be something that many middle schools, high schools, and colleges could implement into their athletes' workout schedules. The program consists of a multicomponent program including strength, flexibility, balance, and plyometrics. This is something that is progressive in nature with 4 levels of exercise. This would be performed 2-3 days per week as a part of the practice and only takes 15 minutes. Implemented as a dynamic warmup at the beginning of practice and also includes fatigue state training that is performed at the conclusion of practice. Targets all high-risk sports and female athletes. Research is showing not only a reduction in all lower extremity injuries but also improvements in performance measures (SportsMD, 2018).

Other Causes of Injuries

Although technology in sports is growing, there are many other factors that are contributing to the surge of injuries within the youth and amateur sports. The most talked about a contributor to youth injuries is sport specialization. Sport specialization has been associated with an increased risk of lower extremity injuries (LEIs) in youth athletes. Sports specialization is defined as intense, year-round training in a single sport with the exclusion of other sports (Jayanthi et al, 2013). There is a general assumption that the number of hours spent in specific

practice and training positively correlates with success in sports. What people fail to see is that sport specialization may lead youth to stop playing sports whether it's from burnout in that particular sport or in our case for this study too many injuries.

In a study done on sports specialization and injury, participants were recruited from 29 Wisconsin high schools. These participants completed a questionnaire identifying their sport participation and history of lower extremity injuries. They would also determine sport specialization of low, moderate, or high was determined using a previously published 3-point scale. Then, athletic trainers reported all LEIs that occurred during the school year. The results showed that athletes with moderate or high sport specialization were more likely to sustain a leg injury than athletes with low specialization (McGuine et al, 2017). This goes to show that sports medicine providers need to educate coaches, parents, and youth athletes on the increased risk of LEIs for athletes who specialize in a single sport.

Methods

Participants

The participants in this study would be recruited from around the Midwest. The study would aim to study over 500 youth and amatuer athletes that range from 12-19 years old that play sports. Half of the athletes would specialize in a noncontact sport, while the other half would specialize in contact sports. The study would also be strategically designed in order to equally represent both genders and three different age groups. Age groups represented in this study will be: Girls 12-14, Boys 12-14, Girls 14-16, Boys 14-16, Girls 17-19, and Boys 17-19.

Procedures

Each athlete represented in this study before their season will be sent a survey that will allow us to see their current status as an athlete. This survey will ask many questions including:

Whether their sport is contact or noncontact? Whether or not they have had prior injuries to this study? What technology do they or have they used in order to prevent or track injuries? In order to recruit participants, teams, and athletes. Multiple high school athletic associations, athletic directors, and travel teams will be contacted throughout the Midwest. The survey will be sent via email and we will ask for athletes from age 12-19 years old to participate in this study.

During the course of the athletes seasons, athletes will be asked to report a bi-weekly survey to keep up with their health status. These bi-weekly surveys will allow them to see if there has been any injuries during their season, and it will also allow them to report what their injury was. This data would be collected during the entirety of the athletes 2023-2024 seasons.

Once all the data is collected from our 500 participants, any correlations will be seen for the study. What the study will be looking for within the results would be, does technology have a relationship in the number of injuries within youth sport? We will split all the participants into two groups. One group of athletes would be those who have taken the precautions of wearing technology or using a technology that aids them with injury or injury status. The other group will be those that do not or have not used those technologies in their playing career. In the end, the data will show that technology does correlate to injuries that youth athletes are having or it will show that it is merely something else causing these injuries.

Ethics

In this study, athletes' identities will be withheld to protect them from potential repercussions. There is a potential for coaches to be upset if their athletes report injuries, especially contact injuries like concussions. Athletes will also sign a consent form that details all

the research we are doing and this form will also allow them to opt-out at any time if they get uncomfortable.

Conclusion

This research paper sought to answer if the improvement of technology in sports equipment is helping to reduce injuries in youth sports. The research found some mixed answers. The question is too simple and surface-level to describe the different variables that currently go into answering this question. It doesn't take into account other factors that are causing injuries such as overuse and sports specialization. It also doesn't take into account the increased education about certain injuries like concussions.

With technology making the advancements it has been, there may be evidence that technology can play a role in youth injury. As technology keeps advancing, there are many different periods of testing that they have to go through, therefore with that being said, users might not be as experienced with the technology they are using. When the user isn't as experienced with the technology it can cause the athlete to misuse the item and therefore causing an injury. As much data can be presented on how good these technologies are for athletes, it may come down to how well taught are than on how these technologies work. Not being taught or learning how they work, can cause injury, and therefore saying that the technology might not work, or it can come back on them and give false results then the athlete stops using the technology for it being wrong and they become injured.

Contact injuries like concussions were found to be increasing despite football helmet technology getting better. Some studies that were used in this paper suggested that the number of concussions isn't necessarily going up, but the number of concussions that are reported is growing. The increased education on head injuries and CTE in football is thought to have

influenced the number of reported concussions heavily. Data backs up concussions rising in the past decade. One study said concussions have risen 71% in ages 10-19 from 2010-2015.

Non-contact injuries such as ACL tears are rising in youth athletes and these injuries can have possibly lifelong effects such as posttraumatic osteoarthritis. Knee injuries are responsible for 15% of high school athlete injuries with 25% of those having to do with the ACL. There are over 250,000 ACL injuries in the United States each year, with around 75% requiring reconstruction of the ligament which means athletes sit out multiple months as they recover. Research also looked at ankle injuries which bring their own brutal side effects. Ankle injuries account for 23% of high school-related injuries. 85% of these injuries are lateral ankle sprains that can carry lifelong problems. 75% of those who suffer ankle injuries suffer from chronic ankle instability.

One method that is helping to prevent lower body injuries is the Play-IT-Safe program. This is a program that is performed 2-3 times a week that brings together many components such as strength, flexibility, plyometrics, and more. While research is showing a decrease in injuries, it is also showing an improvement in performance with this program.

As mentioned earlier, sports specialization is a leading cause of the injuries we are seeing, especially with the lower body in young athletes. This is because they are using the same movement patterns year-round and data shows this is hurting them. A study in Wisconsin showed that athletes with moderate to high sports specialization were more likely to have a lower-body injuries.

Overall, to answer the question, the data shows that injuries are not going down for youth sports despite technology getting better. However, it is not as simple as looking at technology.

Other factors such as more education, more accountability for reporting injuries, and the rise of sports specialization are major reasons that injuries have risen in youth sports.

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