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Perceptions of NCAA Division I Baseball Pitchers on Treatment Modalities for Pitching Arm Health

Thomas Williams
Winthrop University

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To the Dean of the Graduate School:

We are submitting a thesis written by Thomas Williams entitled PERCEPTIONS OF NCAA DIVISION I BASEBALL PITCHERS ON TREATMENT MODALITIES FOR PITCHING ARM HEALTH.

We recommend acceptance in partial fulfillment of the requirements for the degree of Master of Science in Sport and Fitness Administration through the Richard W. Riley College of Education.

Dr. Joni Boyd, Thesis Advisor

Dr. Alice McLaine, Committee Member

Dr. Janet Wojcik, Committee Member

Dr. Jennie Rakestraw, Dean, College of Education

Dr. Jack E. DeRochi, Dean, Graduate School

PERCEPTIONS OF NCAA DIVISION I BASEBALL PITCHERS ON TREATMENT MODALITIES FOR PITCHING ARM HEALTH

A Masters Thesis

Presented to the Faculty

Of the

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Abstract

Throwing athletes of all sports have similarities, even if the sport itself is very different. Throwing an object creates a great amount of stress on the body, particularly at the shoulder and the elbow. A baseball pitcher should train and compete in all three planes of movement-sagittal, frontal and transverse. Training for throwing athletes has two main goals: to increase throwing power and to reduce throwing injuries. Analyzing training habits of a throwing athlete includes an understanding of the modalities they perform in order to prevent potential injuries from occurring. Baseball pitchers are extremely susceptible to throwing injuries, and must be proactive in training and treatment modalities to reduce the risk of injuries. It is critical to better understand the perceptions of the various treatment modalities that pitchers believe are effective so athletic trainers, strength coaches, pitching coaches, and pitchers can work together to minimize injuries and maximize potential. The survey in this study aimed to investigate the perceptions of college baseball pitchers on the modalities and treatments available for arm recovery. This self-reported study pointed on a variety of trends that were congruent with the initial expected results, as well as providing insight to new and unexpected results. Results showed that pitchers were devoted to certain modalities that they preferred, regardless of time, over 70% of athletes listed using recovery modalities multiple times per week. The majority of responses reported perceptions of effectiveness for heat and rolling techniques. Additionally, the pitchers believe that dry needling and Graston techniques are most effective, although most of them do not perform them regularly. Additional research is needed to further the development of baseball pitching recovery modalities.

Key Words: modality, baseball pitchers, recovery, proactive motion, college athletes.

A REVIEW OF LITERATURE ON THE TREATMENT MODALITIES FOR BASEBALL PITCHERS

Introduction

Perceptions of recovery modalities are vital to the health of a pitcher's performance, as it is the athlete's most important asset for their sport. Often, a pitcher may feel fine after completing a pitching rotation, but wake the next day with high levels of soreness and/or pain at the elbow. Delayed onset muscle soreness (DOMS), as well as extreme fatigue, increases the risk for elbow injuries, but is a daily stress that a pitcher's elbow must endure. Since there is still debate on the causes of injuries that baseball pitchers typically experience, developing a "pre-hab" injury prevention program is critical. Identifying modalities and available productive treatments is critical for pitchers to maintain a healthy elbow and arm, as well as maximizing their on-field performance. It is important to consider the soreness created from pitching in the elbow is much different than muscle soreness from regular exercise The muscles and connective tissue are worn down faster based on the stress the joint experiences during everyday life, exercise and pitching. A better understanding of the pitcher's stress and the effect of the various modalities available is critical for further development of injury prevention programs.

Arm Stress of a Pitcher

Just how much stress does a pitcher's arm endure? A study was conducted of 51 baseball pitchers and 34 baseball 'position players' (the hitters, who throw daily but not with the amount of force intent as a pitcher). Participants underwent a blood flow examination on their throwing arms measured by daily ultrasound. The study used the ultrasound to measure the athletes; the ultrasound was conducted by holding the athlete's

arm in a throwing motion to increase the validity of measurement. According to a study done by (Laudner et al., 2014) results showed that pitchers had much less blood flow in their throwing arms than the position players did. The findings from this study is important because training muscles to move dynamically through exercise is difficult to do, but throwing in addition to other training creates additional concerns that are specific to a baseball pitcher. There is an increased injury risk, as one wrong movement mechanically in throwing, lifting, or training can be devastating to a pitcher's performance.

Previous research has examined whether injuries to a pitcher's elbow are preventable, or whether it is inevitable because of the complexity of the pitching motion, Laudner et al., 2014. Pitchers use a tremendous amount of force when throwing, which requires the entire body to be in motion to execute just one single pitch effectively. As a baseball pitcher, the common belief is that injuries to the pitching elbow are likely; it is just a question of when they may occur.

The literature used in this study is relative to the effects of DOMS for a pitcher's elbow. This also includes the stress of pitching on the athletes' body and arm. These stresses are serious, and the right recovery modality and treatment can help to minimize lasting effects on the arm, and assist in regaining health and optimal performance for the athlete. A sore elbow due to pitching can be caused by many stressful factors, but the overall body has an important role in dictating how much stress a pitcher's elbow will endure when throwing. The kinetic chain or entire human body is vital in the synchronization of the pitching motion. This allows the motion to be executed effectively

with as minimal stress as possible. This group of literature covers the importance of the human body in the pitching motion, the muscles that contribute to throwing a pitch and how the biomechanical process helps identify the actual causes of stress on a pitching elbow.

The overhead throwing motion for a pitcher is highly un-natural and unique. A pitcher's motion is also very intricate, containing many movements that may cause bodily stress and risk injury. To execute a pitch the body or kinetic chain must work completely in synchronization for it to be successful. Laudner et al. (2014) noted the arm path is working with the movement of the lower body as a pitching motion occurs. This causes the torso and hips to activate the upper back and shoulder musculature to let the arm know it's time to move violently to throw a pitch. Laudner, et al. (2014) also described the motion as highly complex and almost dangerous if done incorrectly.

The pitching motion is highly complex and requires an advanced athlete with vast training experience to be able to compete at a high level. A strong example of this complex motion would be the biomechanics of an athlete's shoulder and elbow when executing a pitch with maximum velocity. According to Anderson & Alford (2010), the motion of the kinetic chain working as one connected process from the start of the first leg movement to ending with the ball being released from the fingertips. Laudner et al. (2014) discussed how this exact process can be maximized through perfect synchronization, but also can be dangerous if the slightest deficiency in the process occurs. When a pitch is thrown, the legs or the bottom of the kinetic chain move first. This this will cause a "chain reaction" initiating the rest of the bodily pyramid to act until the pitch is delivered. The biomechanics of throwing are complex, but are consistent

with the types of stress pitching can induce. According to Anderson & Alford (2010), when the arm is going through the phases of pitching a ball, there are high levels of stress put on the arm throughout each phase. The deceleration phase causes tremendous valgus stress on the elbow, as it must completely stop the fast-moving arm. This process is highly complex, as it requires both the acceleration of the arm and the deceleration. The pitching process is so unique; that it can only be broken down into multiple parts (Kancherla, Caggiano & Matullo, 2014). Peak force of a pitch usually comes at the cocking phase, or when the arm brings the ball to shoulder level on its way to be released, just before the deceleration phase. These two phases cause immense amount of stress to the arm, therefore pitching and throwing training should try to maximize these two areas (Anderson & Alford, 2010).

Understanding muscle soreness is imperative for a pitcher because soreness caused by pitching is different than the muscle soreness/fatigue caused by any other exercise. Fore a pitcher the body must be trained to move in all three planes of movement; it must be functional and rotational and it must be strong in vulnerable positions. Previous research has described that muscle soreness varies based on age and force behind the baseball, and soreness is a pitching reality and must be addressed in the pitcher's training regimen (Bush-Joseph, Lewis & Ruby, 2011; Ganley, Leahy & Schorpion, 2015). Being strong and durable in vulnerable positions is a key attribute for a pitcher. This is because the pitching motion puts the body in unorthodox positions that can lead to injury if muscle strength and stability are not present. It is important to note

that a vulnerable position is one that can put the body at risk of injury if the motion or set of motions is not executed in a synchronized efficient order (Ganley et al., 2015).

Shoulder Health

Building a base of strength for pitching is instrumental to preventing injury. The pitcher's shoulder is critical to his performance. Shoulder imbalance may lead to elbow injuries. The kinetic chain is a giant collection of the human body working together to execute in this case, a pitch. A strong shoulder base is vital in pitching because it helps to maintain a structure for the entire arm to rely on for safety and strength (Jaeger, 2013). The shoulder is the foundation for the pitching arm. This is to say that if something is wrong with the shoulder, it can throw off the entire arm and lead to injury. Ganley (2012) and Wilk (2012) discussed the importance of shoulder strength and endurance at a young age. This is needed to prevent injury over time for young pitchers. If adolescents can master some simple shoulder strengthening exercises at a young age, it will be instrumental in the long-term health of their pitching elbow and shoulder (Jaeger, 2013). Arm health has its benefits for long-term injury prevention but also aids the entire body by having a stronger synchronization between muscles for an overall athlete at a young age. If the body can work together at a young age, as in not having any muscle imbalances, it can reduce potential stress on the entire pitching arm, which will keep youths healthy (Kissenberth et al., 2015).

Youths now play baseball all year, which is great for the game. However, it is simply extremely stressful on the arm because it breaks down the muscles and joints, which in turn will lead to injuries. 'Little league elbow' is a popular term to describe

elbow pain of adolescent baseball players ages 10-13. Ganley et al. (2015) and Chalmers, Riff, Sgroi, (2015) believe that rest is just as important for shoulder health as is the training for shoulder health. Rest is vital for the health of a young pitcher's arm because it allows for tissue quality to be restored. This also includes joint relaxation by reducing stress of the joints and muscles and allows the body to recover from the repetitive baseball movements at such a young age (Chalmers et al.2015). This also allows for growth when in fact they do pick baseball back up. If they simply play and play, there is no time for recovery and muscle adaptation, or a disruption of regular bodily homeostasis. By resting the arm, it heals and grows, so when they return, the body can handle the increased stress of the game that grows each year of playing. Kissenberth et al. (2015) and Chalmers et al. (2015) discussed how velocity is hard to predict but have some similar underlying factors that contribute to it.

Height and weight contribute to velocity as well as muscle strength and lack of muscle fatigue. This goes back to the notion of rest for adolescents. This includes both the muscles and the shoulder to relieve exhausted muscles to eventually help them grow and adapt. With this muscle fatigue and stress, certain pain and recovery modalities can be done to contain and prevent these symptoms (Devitt, 2007). Devitt also stated that soft tissue mobilization and thoracic spine activation protocols aid this process by properly activating the decelerating muscles that contribute to a pitching delivery. A strong shoulder base is fundamental for the health of a young pitcher. This base will allow a young pitcher to be strong and have endurance, as well as protect the elbow from stress that can lead to injury.

Kinetic Chain and the Value of Self-evaluation

Muscle stability and strength can be very important for the success of a pitcher. With this comes flexibility and strength to perform functional movements effectively. The kinetic chain works as a single working unit to help a pitch be delivered, and it works to efficiently allow the body to operate in a way that minimizes stress on the elbow. If there is slight muscle instability, it can lead to injury (Bush-Joseph et al. 2011). Ensuring each muscle is properly warmed up will allow the body to work at a highly functional level. Functional mobility refers to how muscles can overcome any imbalances in the body to execute a pitch to the body's best ability (Chang, Greco & McCliney, 2014). The kinetic chain delivers a pitch in a coordinated way from the ground up. Sore muscles can be managed and used better than overworked and fatigued muscles (Bush-Joseph et al., 2011).

Muscle mobilization is one way we can assure our kinetic chain is working together and properly. Muscle soreness should be managed for movements to be more functional, which is exactly what's needed for executing a pitch (Markovic, 2015). When using muscles for maximum performance, peak force and fast twitch movements are needed to properly execute various muscle movements. If the lower back and hips are imbalanced or have asymmetry's than injury risk is heightened. Chaundry and Findley (2014) discussed about how important pre-muscle mobilization is for exercise. When warming up a muscle it is important to start with your legs and end with your upper back or shoulder musculature to synchronize the kinetic chain in a coordinating sequence. The authors stated that it is all one part working together and because injury is prevalent, an

athlete must realize this incredibly important connection. This is the same for the pitching motion; it begins from the ground up, ending with the arm releasing a baseball. According to Rodgers, Sullivan & Wilson (2002), this connection in relation to fatigued muscles and peak force output for a thrower. Often throwing is executed after a period of fatigue, which puts the elbow at risk for injury. Managing muscle fatigue is vital in the mobilization for the muscles to reach peak performance. In other words, if a pitcher is sore, they cannot expect peak force or velocity to be high if they are working with overworked or exhausted muscles. Understanding the balance of their muscle limitation will help an athlete get the most out of their training.

Elbow Biomechanics and Strength

The biomechanics of the elbow are unique and deliberate. The elbow joint itself contains many differing parts that allow the joint to perform many movements. For throwing an object, enormous amounts of stress are put on the elbow. When the elbow joint switches up its rotated position in a throwing motion from supinated to pronated, stress is more than doubled (Omori, Miyake & Oka, 2015). This stress is due to the highly complex pitching motion that can be very harmful to the health of a pitchers elbow as well as the entire arm. A full season of pitching can cause adaptive changes to the structure of the entire elbow; this may be detrimental for development overtime (Keller, Marshal & Bey, 2014). These changes include Ulnar Collateral Ligament (UCL) heterogeneity and thickening and increased ulnohumeral space laxity. Basically, pitching can cause the UCL to an adaptive shift into unnatural spaces, which puts the elbow at risk for injury.

When examining the pitching delivery, it is important to analyze the mechanical breakdown in its entirety, including the arm path taken to execute a pitch with maximum force. Strength plays a large roll in pitching, but is only one piece of the mechanical breakdown of the throwing motion. This can contribute to effective pitching and high force with velocity. The arm kinetics makeup the pitching motion that is a biomechanical breakdown of exactly how much force is placed on the elbow during a pitch thrown with high maximum force (Crotin, Bhan & Ramsey, 2015). This means that strength can help with a pitch if the arm path biomechanics are congruent with an efficient arm path. This can also mean that a lack of strength in the arm can lead to an inefficient arm path which has previously been stated to lead to injury.

A great study that goes along with an efficient arm path compared to strength would be one that analyzes multi-body power with velocity. In 2012, Jinji, Ohta and Ozaki executed a study that analyzed the strength across the entire kinetic chain working to together to throwing a ball with maximum force. The most efficient arm paths that were congruent with a baseline level of strength were noted to have to the highest velocity when pitching. The lesser efficient arm paths with lower bodily strength levels were made up of the lowest throwing velocities. Strength and arm biomechanics go hand in hand as they require a link to throw with maximum force, as well as protecting the arm from harmful stress and potential injury (Slenker, Limpisvasti & Mohr, 2012). Biomechanical breakdown of the pitching delivery is instance feedback for stress on the arm and how efficient the arm and kinetic chain are working to deliver a pitch most effectively. With this stress and fatigue related literature, the study and specifically the survey will go through several treatment modalities as to what can help maintain optimal

arm health and performance. Some of these treatments included rolling techniques, added band work, dry needling, graston work and the use of NSAID's (anti-inflammatories). There is a study that supports the positive effects on the body and specifically muscles with the use of NSAID's, immediately following athletic performance (Toumi & Best, 2003). The various treatments in the study will help identify what pitchers use to gain optimal arm strength and peak performance.

PERCEPTIONS OF NCAA DIVISION I BASEBALL PITCHERS ON THE AVAILABLE MODALITIES FOR RECOVERY OF THEIR PITCHING ARM

Abstract

This survey intended to investigate the perception of recovery modalities for a group of collegiate pitchers and their arms. The survey is relatively unique in that it does not just look for what recovery treatment works and what does not but also understanding what certain athletes may think works or would work-yet they do not actually perform a given treatment for their own arm health. This is where the perception of modalities comes in. Arm health is vital for baseball and for pitching success, so finding out what treatments for recovery are most popular can help understand in greater depth exactly how to keep the arm healthy and help minimize recovery time. The study included 10 Division I pitchers, all with their own unique set of skills and throwing motions, also with their own habits and routines to keep their arm fresh. The study will analyze this exact idea, what works and what does not work for them, as well as what may potentially work (or does work for someone else) that a pitcher might not do on their own. Just like anything in sports, some treatments, practices or plans work and some don't, its usually very specific and individualistic, and this survey does not intend to be any different, the data will just show what modality(s) can be efficient and productive to help understand what it is that works or does not work. Recovery is key, the better a pitcher recovers, the quicker they can get back to the mound and pitch, finding ways to understand exactly how to do that is the goal of this survey.

Introduction

Perceptions of recovery modalities are vital to the health of a pitcher's performance, as it is the athlete's most important asset for their sport. Often times, a pitcher may feel fine after completing a pitching rotation, but wake the next day with high levels of soreness and/or pain in the elbow. Delayed onset muscle soreness (DOMS), as well as extreme fatigue, increases the risk for elbow injuries, but is a daily stress that a pitcher's elbow must endure. Since there is still debate on the causes of injuries that baseball pitchers typically experience, developing a "pre-hab" injury prevention program is critical. Identifying modalities and available productive treatments is critical for pitchers to maintain a healthy elbow and arm, as well as maximizing their on-field performance. It is important to consider the soreness created from pitching in the elbow is much different than regular muscle soreness created by working out. The muscles and connective tissue are worn down faster based on the stress the joint experiences when pitching. A better understanding of the pitcher's stress and the effect of the various modalities available is critical for further development of injury prevention programs.

The pitching motion is simply exhausting on a personal level, but also with the extreme fatigue it causes the muscles used to pitch, as well as the muscles used to help recover. The better a pitcher can recover, the more likely they are to first pitch again, but also pitch at a high level with optimum performance, compared to a pitcher who has not properly recovered and is battling a "sore arm". Pitching will cause the arm to become exhausted and overworked, that is known to be true, however what is still open for

discussion and research would be the best way to get back out on the mound, fully recovered. This is what the study will aim to do. The survey that will be taken will hopefully provide a better understanding of recovery modalities for a pitcher's elbow, as well as the perceptions of those modalities. What treatment is most popular, what treatment is the most liked, what is the most used, what treatment is highly popular but not used, among other questions that need to be answered. If recovery modalities can be examined to find what works best, so can the perceptions of modalities and the survey will bring both ideologies together.

Methods

Procedure

The study used an internet-based survey to investigate the recovery modalities and available treatments for the health of a college pitcher's arm. The survey included 50 items and took about 10 minutes to complete. The survey was distributed by email to 15 collegiate pitchers at in January of 2017. The Institutional Review Board approved the study, and participants were given a written statement at the beginning of the survey and directed to complete the survey if they consented to be in the study.

Participants & Recruitment

Baseball pitchers at a National Collegiate Athletic Association (NCAA) Division I university in southeastern United States were recruited for this study. Once institutional review was received, permission was also received from the athletic director and the baseball head coach. The pitchers then received an email with a link that directed them to the survey, and the coach and athletic trainer encouraged and reminded the pitchers to complete it.

Instrumentation

The survey was conducted in Rock Hill South Carolina, using an online survey tool, Qualtrics, and distributed to the athletes on their university email addresses. The questions were developed following the literature review of arm stress, arm fatigue and contributing factors into preventing these symptoms that are felt after the stressors of pitching Demographics were assessed with two items regarding age and year in collegiate career. Baseball demographics were assessed with six items regarding the number of years pitched, injury history, type of pitcher, and an estimated range of number of pitches/ throws per week. For the purposes of this study, the data focused primarily on two main questions concerning modalities. First, the pitcher was asked to report how often they performed any of the following treatment modalities for the health of their arm. Nine different treatment modalities were listed (heat, ice, rolling techniques, stretching with an athletic trainer, Graston work, band work, electrical stimulation, dry needling, and taking anti-inflammatories), plus an option for "other." Responses were on a 6-point scale, ranging from "daily" to "never." For any chosen "other," the pitcher was asked to provide the type of modality not listed. Second, the pitcher was asked to report how much they agreed or disagreed with any treatment modalities to improve the health and performance of their pitching arm. Nine different treatment modalities were listed (heat, ice, rolling techniques, stretching with an athletic trainer, Graston work, band work, electrical stimulation, dry needling, and taking anti-inflammatories) plus an option for "other." Responses were on a 6-point scale, five options ranging from "a great deal"

to “not at all” and one additional option for “I haven’t tried this before.” For any chosen “other,” the pitcher was asked to provide the type of modality not listed.

Analysis

Since this is an exploratory study on perceptions of baseball pitchers on the modalities available for the health of their arm, only descriptive information and frequencies were reported. Frequencies and descriptive information was analyzed by the Statistical Package for the Social Sciences.

Results

The participants of this study were 10 baseball pitchers on the Baseball Team. Participants were all male, and ages ranged from 18-23 (M = 20). Half of the participants considered themselves as a starter, and the other half as a reliever. Sixty percent of the pitchers have been pitching for 10 or more years, and sixty percent also reported throwing within a range of 100 -200 pitches per week, while 40% reported throwing over 300 pitches a week. Table 1 provides demographic characteristics of the sample.

Of the 10 that completed the survey, 60% of the pitching staff has been pitching for 10 years or more and 70% said they have had an arm injury at some point during their career that caused them to miss significant pitching time. Previous injuries included: rotator cuff tendonitis and impingement, shoulder fatigue, ulnar collateral ligament sprain or tear, shoulder elbow issues with stress reaction and tendonitis. The reported treatments for those injuries included: rest from throwing (90%), various treatment modalities such as ice, heat, stim, ultra sound (71%) and physical therapy (60%). Only 2 athletes reported surgery to recover from their injury.

A summary is provided for the question "*From the start of the season until the end, how often do you participate in the following modalities?*" Daily routines mostly included stretching with an athletic trainer (40%), using a rolling technique (50%), and band work (60%). Twenty percent of pitchers use heat, ice, stretching with an athletic trainer, and band work 4-6 times per week. Forty percent use ice and take anti-inflammatories 2-3 times per week. The majority of the pitchers used Graston work (80%), electrical stimulation (60%) and heat (50%) at least once in a while. The least popular modality was dry needling, as 50% of the pitchers reported they have never used it and 40% reported only using it once in a while. Table 2 shows all responses for this question.

A summary is provided for the question "*The health and performance of my pitching arm is improved by:*" with responses referring to nine different types of modalities that could be performed before or after pitching. The most influential modalities reported by the pitchers were rolling techniques, band work, and stretching, and all three modalities were preferred to be performed both before (70%, 70%, 80% respectively) and after (70%, 90%, 50% respectively) pitching. A greater percentage of pitchers reported using ice (60%) and taking anti-inflammatories (50%) after pitching as an effective modality to improve the health and performance of their pitching arm. Heating before pitching (50%), electrical stimulation before (30%) and after (40%) pitching, and Graston after pitching (30%) were reported by the pitchers to help their arm performance "a moderate amount." The pitchers were least impressed with Graston and electrical stimulation before pitching. Icing before pitching, heat after pitching, and dry

needling at any time were the modalities that most of the pitchers had never done. Table 3 shows all responses for this question.

Discussion

After gaining the perception of each of the modalities, some trends have stood out. First, many of the modalities have specific occurrences in terms of time. More athletes like to heat their arm before throwing, not after. More athletes like to ice after throwing, not before. Some modalities seem very individualistic in their occurrence. In terms of stretching before or after throwing, the results were split. Rolling techniques were popular among the pitchers both before and after throwing. This may be the most surprising because rolling technique tends to gives off an immediate response into how the athlete is feeling. A foam roller or lax ball roll claims to alleviate muscle tensions instantly through myofascial release. Graston work was unpopular to perform, as expected, but surprising that the pitchers perceived it to be very useful. It's an uncomfortable technique that involves a dull blade to rub the skin until it turns red. This technique provides an immediate response, which would normally be popular amongst the pitchers to 'feel' better, but our results show that the pitchers only perform it once in a while, despite the positive perception of its effectiveness. Band work was also one of the more popular modalities among the pitchers. Electrical stimulation was unpopular both before and after throwing, its time consuming and doesn't provide immediate apparent feed back to the athletes, most likely making them feel as if it doesn't help. However, according to Zanotti (2003), muscles can experience added strength and minimized fatigued after the use of electrical stimulation. The pitchers may need to get over the time it takes for the treatment and try out the e-stim. Dry needling was widely unpopular, as

expected. It's can seem scary since it involves needles, and can be painful. Lastly, it is interesting that all the pitchers reported using anti-inflammatories, and all perceive taking them to be at least a little effective in improving the health and performance of their pitching arm. According to Toumi and Best (2003), taking anti-inflammatories after performance can have direct benefits to the recovery process of the muscle, after extreme levels of fatigue. This would support the pitchers that choose to take them after pitching. The study also discusses the immediate affect following athletic performance, but it is not the long-term answer to muscle fatigue. The short-term affect has shown to be affective; the long-term affect however has not been identified as a link to NSAID's. This is where the other recovery modalities show a significant role in the recovery process.

Limitations and Strengths

This study has many strengths, as well as a few limitations. Some of the limitations include a survey that is completely subjective and self-reported. In stating this, the athletes whom answer this study, are relying on their own knowledge and own belief on what recovery modality works for them. The small sample size is another limitation for the study, the more participants the better for a survey with data like this. Another limitation would be the reliability and validity of the study.

One of the strengths of the study is that it is a survey exploring an under-researched area of study in injury prevention perceptions for baseball pitchers. Many studies aim to examine the treatments, which this study does, but few aim to examine the treatments and the perceptions of those treatments. Similar to what the results pointed to, just because a pitcher doesn't do a given treatment to recover, does not mean that they don't believe that it can or does work. The way one pitcher throws compared to another

is always going to be different and specifically unique to the individual, the same goes for recovery. How modalities work and why they work for certain individuals is what makes this topic so unique and complex, but just as equally making it effective and potentially productive.

Conclusions

Some final conclusions can be made regarding this study. The first conclusion would be for the modalities, they are time specific and highly individualistic. As a whole, each modality had its own time specific occurrence, heat was more popular before throwing, ice was more popular after throwing. Some modalities were more popular then others, and some were both popular and done before and after throwing (rolling techniques and stretching with the ATC). The more elaborate modalities, the treatments that took longer or had a varied immediate response were less popular then others. This was expected however, pitchers want to 'feel' something work quickly and if it does give that apparent response, they choose something else. This was found in the graston technique, dry needling and electrical stimulation. For the perceptions of the modalities, each modality in the survey was supported through the perception of whether the treatment worked or could work. This is what made the survey unique and specific, several occurrences showed the pitchers saying that 'they don't do this modality' but reported they can see its effectiveness or support that it can help with arm health and recovery. This was not expected-rather expecting to see only what modality would work for each pitcher. Pitchers are unique, as the literature has shown the complex motion of pitching and the immense stress that is one a pitcher's arm and body each pitch. The

recovery that they choose to do and the perceptions of recovery showed to be no different, unique.

Tables

Table 1.

Sample characteristics

Characteristics	n	%	*M*	*SD*
Male	10	100		
Age	10		20.2	1.10
Pitching Year College Level				
First year	2	20		
Second year	2	20		
Third year	3	30		
Fourth year	3	30		
Position				
Reliever	5	50		
Starter	5	50		
Years Pitching Overall				
1-4 years	1	10		
6-9 years	3	30		
10 + years	6	60		
Number of Pitches per week				
100 - 199	6	60.0		
200 – 299				
300 or more	4	40.0		
Sustained a Previous Injury	7	70		

Note: n = number of participants; *M* = mean; *%* = percentage of sample

Table 2.

Frequencies of Modalities

"From the start of the season until the end, how often do you"

TPW	Daily	4-6 TPW	2-3 TPW	1 TPW	Once In a while	Never
Heat	0	2	1	0	5	2
Ice	0	2	4	1	2	1
Stretching with an AT	4	2	3	0	1	0
Rolling techniques	5	1	1	2	1	0
Graston work	0	0	1	1	8	0
Band work	6	2	1	1	0	0
Electrical stimulation	0	0	2	1	6	1
Dry needling	0	0	0	1	4	5
Take anti-inflammatories	0	1	4	2	3	0

Note: TPW = times per week; AT = athletic trainer

Table 3.

Perceptions of Modalities
"The health and performance of my pitching arm is improved by"

	A great deal	A lot	A moderate amount	A little	None at all	I have not done this before
Heat bp	0	3	5	2	0	0
Heat ap	0	0	1	2	2	5
Ice bp	0	0	0	1	1	8
Ice ap	1	6	1	1	1	0
Stretching bp with AT	4	4	1	1	0	0
Stretching ap with AT	3	2	0	2	0	3
Rolling techniques bp	6	1	1	0	2	0
Rolling techniques ap	4	3	0	1	1	1
Graston bp	0	3	0	2	3	2
Graston ap	0	3	3	3	1	0
Band work bp	5	2	1	0	0	2
Band work ap	5	4	1	0	0	0
e-stim bp	0	0	3	1	3	3
e-stim ap	0	1	4	1	1	3
Dry needling bp	0	1	0	1	1	7
Dry needling ap	1	1	0	3	1	4

Taking NSAIDs bp	2	3	3	2	0	0
Taking NSAIDs ap	1	5	1	2	0	1

Note: bp = before pitching; ap = after pitching; AT = athletic trainer; e-stim = electrical stimulation; NSAIDs = anti-inflammatories

Appendix

Qualtrics Survey

How do the perceptions of recovery modalities affect fatigue in a Pitchers arm?

Q33 You are being invited to participate in a research study that is examining the perception of arm recovery modalities for a NCAA Division I pitcher. This survey will measure the frequency of modalities used for recovery and treatment. Additionally, it will measure your perception of the effectiveness of the arm recovery and the modalities that are available to you. If you chose to take part in this study, you will be asked to complete a survey that will take about 10 minutes. This study consists of a series 40 total questions pertaining to demographic data as well as the usage and perceptions of arm recovery and modalities available to you as a pitcher. As a participant you will not benefit directly from this study. However, your participation will be greatly appreciated for the completion of research to contribute to the growing field of injury prevention. A number of studies have been done on recovery, and what may or may not be effective for pitchers. However not many surveys on the perceptions of recovery modalities have been done, making this survey highly interactive and important in the baseball world. A lot of times recovery is done aimlessly, without knowledge or actual input whether or not it works, this survey can aid to help close that gap. The information you provide will remain private. Survey participation is anonymous. Information obtained through this study will only be used by the research staff. All data will be kept secure online using encrypted passwords. Please know that your participation in this study is voluntary. If you choose not to take part in the survey, there will be no penalty. You may quit the study at any time by closing out of the survey. You may also choose not to answer a question without penalty, although we greatly appreciate your full participation. All data is kept private and confidential, only the results will be reported. Your choice to participate or not participate in this study will not reflect on you as a student or a student athlete of the University. Your information will be used strictly for this research study only, will not be shared with anyone else, and you will not receive any spam emails related to participation in this study. If you have any questions or concerns, we encourage you to contact:Thomas Williams a winthropt55@winthrop.edu or Dr. Joni Boyd at boydj@winthrop.edu You may also call the Office of Sponsored Programs at Winthrop University at 803-323-2460. By choosing to continue, you agree to take part in the study. Thank you for interest in the study. Thomas Williams Sports and Fitness administration College of Education Winthrop University

Q38 Are you a baseball pitcher on Winthrop University's baseball team?

- ❍ yes (1)
- ❍ No (2)

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Q18 What is your age?

- ❍ 17 (1)
- ❍ 18 (2)
- ❍ 19 (3)
- ❍ 20 (4)
- ❍ 21 (5)
- ❍ 22 (6)
- ❍ 23 (7)

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Q19 What year are you in your competitive college career?

- ❍ 1st (1)
- ❍ 2nd (2)
- ❍ 3rd (3)
- ❍ 4th (4)
- ❍ 5th (5)

Q20 How many total years have you been pitching?

- ❍ 1-5 years (1)
- ❍ 6-9 years (2)
- ❍ 10 years or more (3)

Q21 Have you suffered an injury to your pitching arm at any time?

- ❍ yes (1)
- ❍ No (2)

Q24 Did the injury cause you to lose pitching time?

- ❍ yes (1)
- ❍ No (2)

Q26 What type of injury or injuries have you experienced to your pitching arm?

Q23 What did your injury require in order for you to heal and return to playing status? (check all that apply)

- ❑ rest from pitching / throwing (1)
- ❑ treatment modalities (ice, heat, e-stim, ultra sound, etc) (2)
- ❑ physical therapy (3)
- ❑ surgery (4)
- ❑ other (5) _____

Q32 What role do you consider yourself for the current season?

- ❍ starter (1)
- ❍ reliever (2)
- ❍ other (3) _____

Q34 In a normal week during the season, how many pitches do you throw per week, on average (including games and practices)?

- ❍ 100+ (1)
- ❍ 200+ (2)
- ❍ 300+ or more (3)

Q28 For the next section, please indicate how often you perform any of the following for the health and performance of your pitching arm. From the start of the season until the end, how often do you.....

	Daily (1)	4-6 times a week (2)	2-3 times a week (3)	Once a week (4)	once in a while (5)	Never (6)
heat your pitching arm (1)	❍	❍	❍	❍	❍	❍
ice your pitching arm (2)	❍	❍	❍	❍	❍	❍
stretch with an athletic trainer (3)	❍	❍	❍	❍	❍	❍
use a foam roller, lax ball, or any other rolling technique (4)	❍	❍	❍	❍	❍	❍
perform graston work (5)	❍	❍	❍	❍	❍	❍
perform band work (6)	❍	❍	❍	❍	❍	❍
get electrical stimulation (e-stim) (7)	❍	❍	❍	❍	❍	❍
perform dry needling (8)	❍	❍	❍	❍	❍	❍
take anti-inflammatory or pain reliever (9)	❍	❍	❍	❍	❍	❍
other (10)	❍	❍	❍	❍	❍	❍

Q35 If you selected "other" in the previous question, please describe here:

Q27 For the next section, please indicate how much you agree or disagree with that statement. The health and performance of my pitching arm is improved by:

	A great deal (1)	A lot (2)	A moderate amount (3)	A little (4)	None at all (5)	I haven't done this before (6)
using heat before pitching. (1)	❍	❍	❍	❍	❍	❍
using heat after pitching. (2)	❍	❍	❍	❍	❍	❍
using ice before pitching. (3)	❍	❍	❍	❍	❍	❍
using ice after pitching. (4)	❍	❍	❍	❍	❍	❍
stretching with an athletic trainer before pitching. (5)	❍	❍	❍	❍	❍	❍
stretching with an athletic trainer after pitching. (6)	❍	❍	❍	❍	❍	❍
using a foam roller, lax ball, or other rolling techniques before pitching. (7)	❍	❍	❍	❍	❍	❍
using a foam roller, lax ball. or other rolling techniques after pitching. (8)	❍	❍	❍	❍	❍	❍

performing graston work before pitching. (9)	❍	❍	❍	❍	❍	❍
performing graston work after pitching. (10)	❍	❍	❍	❍	❍	❍
performing band work before pitching. (11)	❍	❍	❍	❍	❍	❍
performing band work after pitching. (12)	❍	❍	❍	❍	❍	❍
getting electrical stimulation (e-stim) before pitching. (13)	❍	❍	❍	❍	❍	❍
getting electrical stimulation (e-stim) after pitching. (14)	❍	❍	❍	❍	❍	❍
getting dry needling before pitching (15)	❍	❍	❍	❍	❍	❍
getting dry needling after pitching (16)	❍	❍	❍	❍	❍	❍

taking an anti-inflammatory or pain-relievers such as ibuprofen, Tylenol, naproxen, etc. before pitching (17)	❍	❍	❍	❍	❍	❍
taking an anti-inflammatory or pain-relievers such as ibuprofen, Tylenol, naproxen, etc. after pitching (18)	❍	❍	❍	❍	❍	❍
other (19)	❍	❍	❍	❍	❍	❍

Q36 If you selected "other" in the previous question, please describe here:

Q16 If you take an anti-inflammatory or pain relievers solely for your arms health, when do you take it? (check all that may apply)

- ❑ daily, even if it doesn't hurt (1)
- ❑ before a start or bullpen (2)
- ❑ when your arm hurts (3)
- ❑ after throwing (4)

Q29 If you had to choose a single treatment method that works best for you, what would it be and why?

Q30 What treatment do you must enjoy, even if it is not the most effective?

Q37 What treatment that you have tried do you believe is least effective and why?

Q31 What treatment would you consider trying that you have never tried before?

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