The Effects of Cryotherapy on Alleviating Pain Utilizing the DVPRS

A Thesis

by

Madalyn Kae Kennedy, ATC

Spring 2019

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The Effects of Cryotherapy on Alleviating Pain Utilizing the DVPRS

A Thesis

Presented

to the Faculty of

California State University, Chico

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Kinesiology

by

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DEDICATION

I dedicate this thesis to people who have continuously supported me in my educational journey and collectively always pushed me to be a better person.

To my mom and Ted, words cannot describe how thankful I am to have had your emotional and financial support during these long 7 years. I can truly say I would not be here without you guys. Mom, you taught me to always know my self worth and to constantly strive to be a better person. I love you so much and hope I continue to make you proud. Ted, I could never thank you enough for doing things you never had to. Not many people are as lucky as I am to have had another parent as great as you. I love you and thank you again for everything.

To my dad, from as young as I can remember you have instilled a confidence in me that I have carried all my life. I know I can always turn to you whenever I need reassurance of that. I could not have accomplished all of this without you, your support, and your never-ending love. I love you and cannot thank you enough.

To my siblings, each of you have supported me in a special way that I am truly grateful for. Misty, you and your family have supported me not only emotionally but financially through this journey and I thank you for that. Your sons are two of the greatest loves of my life and I hope I always inspire them the way you have inspired me. Melanie, in a similar way you and your family have always supported me. Your son is extremely intelligent I hope to encourage him to always be his most perfect self. To Morgan and Matthew, this dedication is especially to you two. With your support, I have pushed myself to be a better person in hopes to show you both the possibilities in life.

You are each so special to me and I cannot wait to see the goals you are both going to achieve. I love you both dearly and I am forever grateful for the trifecta bond we have created.

I would also like to thank Anthony for always being there for me no matter what and encouraging me to be my best self. You have been there for me both emotionally and spiritually. You have shown me what it is truly like to be loved and supported. I love you so much and am forever grateful for you.

To Steven, Tracy, and your family, you took me in and supported me from the kindness of your hearts. I would not have been able to continue undergrad without you both. Thank you for always treating me as family. I hope I have made you both proud. I will forever be in debt to you for the love and kindness you have shown me. You and your family will always have a seat at my table and a spot on my couch. I love you all very much.

ACKNOWLEDGMENTS

I would like to thank my chair, Dr. Jack Azevedo, for continuously supporting me and pushing me to be a better writer. Without your support, I do not think I would have been able to complete this thesis. I would also like to thank Mr. Scott Barker for encouraging me to not only be a better student, but also a better athletic trainer, by completing research that directly benefits this profession. Additionally, I would like to thank all the staff athletic trainers at CSU, Chico who helped me collect data, as well as the CSU, Chico athletes who helped by participating in my study.

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ABSTRACT

The Effects of Cryotherapy on Alleviating Pain Utilizing the DVPRS

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Master of Arts in Kinesiology

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Summer 2019

Cryotherapy is a common treatment among health care professionals but has yet to garner strong empirical data to support its general use. The majority of studies measure variables such as swelling and tissue temperature instead of focusing on the subjects most common complaint: pain. Thus, the purpose of this study is to explore if cryotherapy is effective in alleviating the symptoms of pain in collegiate athletes by utilizing the Department of Defense Pain Scale. Subjects were recruited from a university athletic training center who were seeking cryotherapy treatment. Subjects completed a pre-treatment pain scale, received cryotherapy treatment, 20 minutes, and immediately filled out a post-treatment

pain scale. The pre-treatment pain scale average of the 49 athletes was 3.58 and the average of the post-treatment pain scale is 1.3 and the difference was significant with a $p<0.05$, suggesting that. cryotherapy treatment is potentially effective in alleviating symptoms of pain.

CHAPTER I

INTRODUCTION

Background

Treating pain is one of medicine's oldest and fundamental obligations. Pain is the most frequent reason patients seek physician care in the United States and it affects more Americans than diabetes, heart disease, and cancer combined (Centers for Disease Control and Prevention and American Academy of Pain Medicine, 2009). Athletes are no exception from this. When an athlete comes to seek assistance from an athletic trainer, it is because they are experiencing some level of pain that could be hindering their level of play. It is the responsibility of an athletic trainer to assess athletes' pain and provide adequate treatment. Because pain is subjective to each individual athlete, it is especially important to understand how to evaluate, manage, and treat pain. A lack of ability to address pain in health care systems results in patient suffering, worsening medical conditions, and increasing financial and personal costs (Office of the Army Surgeon General, 2010).

One of, if not, the most basic way health care providers have treated pain, is with some type of cryotherapy. Cryotherapy is simply any form of cold, between 32 degrees Fahrenheit and 65 degrees Fahrenheit, used to treat pain on living tissue. Cryotherapy in its most popular forms utilized the athletic training setting are an ice bag, cold whirlpool, and ice cup massage. Cryotherapy treatment is effective once the subject experiences analgesia or the absence of pain, which is around 18- 21 minutes of treatment. Cryotherapy has been demonstrated to reduce tissue temperature, restrict blood flow, and

reduce swelling. However, there are two important gaps. The literature has yet to demonstrate whether cryotherapy reduces a person's pain. Additionally, most of the studies done on cryotherapy focus on one specific injury, (Bleakley, C. M., McDonough, S. M., & MacAuley, D. C., 2016; Cote, D. J., Prentice, J. R., W. E., Hooker, D. N., & Shields, E. W., 1988; Hocutt Jr, J. E., Jaffe, R., Rylander, C. R., & Beebe, J. K., 1982; Wilkerson, G. B., Horn-Kingery, H. M., 1993) which cannot be generalized to more common injuries such as muscle strains.

The two types of pain athletic trainers usually evaluate and manage are acute and chronic. Acute simply implies there was some type of trauma. This can include anything from an ankle sprain to cranial-facial separation. Chronic pain is a denoting pain that is persistent and can last over six months. Chronic pain often comes with repeated stress on a body part, such as a runner having a stress fracture in the lower leg. Acute and chronic pain can both treated with cryotherapy, but it is important to note the different types of pain still must be assessed properly.

George Engel believed that in order for health care professionals to comprehend and effectively respond to patients' pain, we need to assess the biological, psychological, and social dimensions of illness, thus the biopsychosocial model was made (Borrell-Carrió, F., Suchman, A. L., & Epstein, R. M., 2004). In this current study, general activity, mood, stress, and sleep were the biopsychosocial factors being evaluated in regard to pain. An evaluation of social and environmental factors relevant to the current pain problem is also a core component of psychosocial factors (Hainline, B., Turner, J. A., Caneiro, J. P., Stewart, M., & Moseley, G. L. (2017). Sleep disorders are common among athletes that are recovering from an injury. "Sleep and pain have a reciprocal

relationship—pain disturbs sleep, and poor sleep quality or duration increases pain levels in clinical populations and decreases pain thresholds in otherwise healthy people" (Hainline et al., 2017). Addressing sleep disorders and other biopsychosocial factors could improve performance and the general health of the athlete (Hainline et al., 2017; Borrell-Carrió, F., Suchman, A. L., & Epstein, R. M., 2004).

Music has been shown to connect individuals with their emotions (McCaffrey, 2008) and has been associated with pain-reducing environment (Linnemann, Kappert, Fischer, Doerr, Strahler, & Nater, 2015). Studies have shown that patients who listen to music are often more distracted from their pain when compared to patients not listening to music (McCaffrey, 2008). In a changing hectic environment like the athletic training room, it is important all the subjects are controlled as much as possible; therefore, the current study will utilize self-selected music for each subject.

The DoD developed and validated an 11-point pain scale that can be used by clinical researchers with a simple green, yellow, and red scale suitable for medical conditions. This tool anchors each numeral on the 11-point scale with standardized 'experiential' and 'functional' language, greatly enhancing clarity for both patients and providers when discussing pain levels and treatment effectiveness throughout the care continuum (Office of the Army Surgeon General, 2010). The tool also includes four supplemental questions. These results allow clinicians at all levels to evaluate the biopsychosocial impact of pain. Questions include the impact of pain on general activity, mood, level of stress and sleep. These supplemental questions, when combined with the functionally anchored 11-point scale, provides a potentially powerful clinical tool in

evaluating a patient's pain, considering treatment goals, and establishing the most appropriate treatment plan (Office of the Army Surgeon General, 2010).

Statement of Problem

Cryotherapy has been a mainstay in the health care profession. Recently, it has come into question whether the claims of reducing pain and reducing swelling are accurate. Cote et al. (1998) found that cold therapy clearly resulted in the least amount of edema when compared to contrast therapy, a hot whirlpool for 3 minutes and then a cold whirlpool for 1 minute for 20 minutes, and thermotherapy, a hot whirlpool of 102º to 106º. Although a significant finding, pain was not assessed at all.

Several factors influence the efficacy of cryotherapy, one of which is skinfold thickness. The standard protocol for a cryotherapy treatment is 10 to 30-minutes, however, it has been demonstrated that standard treatment is unsuccessful at penetrating through the subcutaneous fat in an athlete who has a skinfold that exceeds 20mm (Otte, Merrick, Ingersoll, & Cordova, 2002). In the athletics setting, there is a variety of athletes with different body types. Otte, et al. (2002) found that the efficacy of cryotherapy was dependent upon skinfold thickness (i.e. half of the thickness of subcutaneous fat), and that cryotherapy treatment time should be adjusted accordingly (i.e. longer treatment time for greater skinfolds). Unfortunately, this recommendation is unreasonable for most athletic trainers.

Most of the evidence that is currently available is inconsistent or non-specific to cryotherapy alone (Merrick, M. A., Knight, K. L., Ingersoll, C. D., & Potteiger, J. A.,

1993; Waterman, B., Walker, J. J., Swaims, C., Shortt, M., Todd, M. S., Machen, S. M., & Owens, B. D., 2012). The problem with assessing the efficacy of cryotherapy is that combination treatments such as compression or elevation have been utilized in addition to cryotherapy. These confounding variables make it harder to evaluate the efficacy of the cryotherapy as a treatment alone. Cryotherapy has been used for many years in various health care professions, but in order to provide athletes with best care, athletic trainers need to be confident that it is effective.

Purpose of Study

The purpose of this study is to explore if cryotherapy alone is effective in alleviating the symptoms of pain in collegiate athletes by utilizing the DoD Pain Scale. It is hypothesized that the cryotherapy will be effective in reducing the pain. Findings from this study can be implemented in the treatment and care of athletes by athletic trainers. Athletic trainers pride themselves on practicing “best practice medicine”. This includes grounding their treatments in evidence-based practice. The goal of this research is to assist in expanding the research of care associated with evaluating and alleviating pain.

Theoretical Bases and Organization

This present research corresponds with other studies because it is looking into the effectiveness of cryotherapy as a treatment for pain. Cryotherapy has been a theoretical bases of treatment in the health care profession and continues to be a mainstay in the profession. The present research also corresponds to other research in biopsychosocial

and is utilized because pain is often involved with "the interaction of physical and pathophysiologic factors, psychological traits and states, and social-environmental factors" (Office of the Army Surgeon General, 2010). It is hypothesized that cryotherapy is effective in treating an athlete's pain and increasing function.

Definition of Terms

Acute injury – any form of trauma to living tissue (Starkey, C., & Brown, S. D., 2015).

Athletic Trainer (AT)- a health care professional who collaborates with physicians. The services provided by ATs comprise prevention, emergency care, clinical diagnosis, therapeutic intervention and rehabilitation of injuries and medical conditions (National Athletic Trainers' Association, 2017).

Chronic- denoting pain that is persistent and can last over six months (Starkey, C., & Brown, S. D., 2015).

Cryotherapy- any form of cold between 32- and 65 degrees Fahrenheit used to treat living tissue (Starkey, C., & Brown, S. D., 2015).

Limitations

There are some limitations included with this study. In regard to participants, there are both male and female participants, participants from various sports teams, and participants with both acute (after initial 24 hours) and chronic pain. The area of treatment, such as on soft tissue or on bone, can be a limitation because the cryotherapy penetrates different according to the body part. An assumption of the present study is that

the DVPRS will translate from military personnel to National Collegiate Athletics Association Division II athletes.

CHAPTER II

SURVEY AND REVIEW OF LITERATURE

Cryotherapy

The most common way to treat pain is and has been, with cryotherapy. Cryotherapy is defined as any form of cold between 32- and 65-degrees Fahrenheit used to treat living tissue. As early as 2500 BC, Egyptians were using cryotherapy to treat their pain and inflammation. From 1845 to 1851, Dr. James Arnott noted the benefits of applying cold treatment for headaches and neuralgia. Dr. Arnott also used low-temperature solutions comprised of salt and crushed ice to freeze various tumors. The first medical use of liquid air was in 1889, and Dr. Campbell White applied it using either a swab, spray, or brass roller in the treatment of diverse skin conditions including herpes, warts, chancroid, and more. In the 1920s, liquid oxygen became more common in the clinical setting. Dr. Irving and Dr. Turnacliff had found that liquid oxygen successfully treated similar skin conditions as ones treated using other cryogenic substances. In Japan in 1978, whole body cryotherapy was initiated by Yamaguchi. He treated pain and rheumatoid arthritis using freezing treatments in short duration on the surface of the skin. He found that the rapid decrease in temperature on the outer layer of skin led to a sudden release of endorphins and decreased pain sensitivity. Further research led to the development of full cryogenic chambers. These practices persist today and continue to evolve (Bouganim, N., & Freiman, A. 2005).

The most common form of cryotherapy utilized by athletic trainers is applying an ice bag to an affected body part. The ice bag usually consists of some form of crushed ice

in a plastic bag, which can be secured with some type of flexible plastic wrap. Ice bags are usually applied for 20 minutes. Unfortunately, it is difficult to verify this protocol in current research is commonly done “because that is how it has always been”. Recommendations range from 10 to 20 minutes 2 to 4 times per day, up to 30 to 45 minutes every 2 hours (Bleakley, McDonough, & MacAuley, 2016). These inconsistencies make it difficult for athletic trainers to support their clinical work with evidence-based treatment which is why more research needs to be completed.

With the evolution of cryotherapy, it still begs the question, does it actually work for pain? It is common practice in athletic training to treat acute soft tissue injuries, most commonly an ice bag, yet the evidence of the effectiveness is inconclusive. The efficacy of cryotherapy has not been fully elucidated (Hubbard & Denegar, 2004). Further, poor quality of the available evidence is of concern. Many more high-quality studies are required to create evidence-based guidelines on the use of cryotherapy. The paucity of evidence-based research in cryotherapy then puts into question its practice.

Measuring the Effectiveness of Cryotherapy

The effectiveness of cryotherapy is most commonly evaluated by measuring skin temperature (Otte et al., 2002; Long et al. 2005; Merrick et al. 1993). The problem with measuring skin temperature is that no matter if the skin temperature changes, the level of pain the subject is feeling is not being taken into consideration.

The other factors that are problematic with only measuring skin temperature are the various subjects and body types that are encountered in real life situations. A body type of a cross-country female runner is going to be different from a football offensive male linebacker in regard to mass and adipose tissue. This can change the treatment

dramatically, yet, the same protocol for cryotherapy treatments is used. Currently, the common treatment for cryotherapy is a 10 to 30-minute treatment; however, this is based on athletes that are relatively lean and with skinfolds less than 20mm (Otte et al., 2002). Otte et al. (2002) measured intramuscular temperature to find the time needed for a cryotherapy treatment to penetrate the subject's skinfold measurement that is greater than one centimeter. It was found that the common 20-minute treatment is ineffective with patients exceeding that skinfold measurement (Otte et al., 2002). In a similar study measuring depth of penetration, Long et al. (2005) found post exercise the average treatment time to cool intramuscular tissue is 40 minutes.

In order to ensure the cryotherapy treatment is effective, the pain of each subject needs to be individually evaluated with the proper tools to ensure evidence-based practice. Collins (2007) showed there was insufficient evidence to show that cryotherapy was effective in improving clinical outcomes for soft tissue injuries, such as reduction in swelling, range of motion, and pain relief (Sloan, Hain, & Pownall, 1989). Bleakley et al. (2016), found that the amount of cooling is dependent upon the type cryotherapy and time of application. This adds to the idea that most health care professionals rely on empirical evidence yet till have limitations on effective treatments.

However, there are current studies that support the use of cryotherapy in the reduction of symptoms associated with orthopedic injuries. Hocutt Jr, J. E., Jaffe, R., Rylander, C. R., & Beebe, J. K. (1982) compared cryotherapy to heat therapy in grade four (unable to bear weight) ankle sprains. Results showed subjects who initiated cryotherapy within 36 hours reached full activity significantly faster than subjects in the

thermotherapy group. Airaksinen et al. (2003) agreed in a study comparing the efficacy of a novel cold gel with that of a placebo gel in patients with a soft tissue injury. Cryotherapy as also been used as a method of conservative treatment in chronic injuries. Chronic injuries are caused by overuse of the affected area, therefore, for a permanent change biomechanical or surgical changes need to be made. However, to manage a patient's pain, cryotherapy has been used as a form of treatment in injuries such as medial tibial stress syndrome, tendinopathies, stress fractures, and compartment syndromes (Couture, & Karlson, 2002; Wilder, & Sethi, 2004).

Measuring Pain

Currently, the most commonly used pain assessment instrument is the Wong-Baker FACES Scale, which was originally created to help children communicate their pain (Wong-Baker FACES Foundation (2018). This scale uses 7 faces with different expressions to mimic the current pain face the subject is experiencing at the time. Each face progressively represents more pain with small phrases underneath ranked from 0 "no hurt" to 10 "hurts worse". When evaluating pediatric pain this scale has been utilized to exam the children's ability to assess their own pain and correctly rank the FACES in accordance with the pain scale. Results found the scale was successful when presented to children, received strong agreement when ranking the order of the pain, and the children were successfully able to identify the workings of the scale (Bieri, Reeve, Champion, Addicoat & Ziegler, 1990).

When asked if color could be added to the scale for added information the foundation responded with a reminder of the simplicity of the scale and there is no

intention to change it (Wong-Baker FACES Foundation (2018). Over 30 years later, the scale that was intended for children is still being used for children. This is not a bad scale per se, just perhaps not the most appropriate scale created for collegiate athletes.

Another common way to evaluate pain is the Visual Analog Scale (VAS). Bleakley et al. (2016) compared intermittent cryotherapy to the standard 20-minute protocol, there was no significant difference in terms of function, swelling, or pain. It was also found that intermittent cryotherapy had greater pain relief benefits in the beginning stages of treatment, using a 10 cm VAS marked "no pain" at one end and "worst pain ever" at the other end. In some cases, the VAS is an 11-point scale with the addition of 0-10 numbers with 0 being "no pain" and 10 being "worst pain ever".

Airaksinen et al. (2003) utilized the VAS to measure pain, results showed a decrease of 59 to 30 during the first week, to 14 by the second, and to 7 by the end of the study in the cold gel group to result in the conclusion that cold gel therapy was effective.

The VAS seems to be less sensitive to bias than the comparative VAS and is therefore preferable for general clinical use (Carlsson, 1983). Additionally, patients appeared to differ considerably in their ability to use the VAS reliably. The VAS has received a great deal of negative feedback regarding the use and perceived value of the scale (Office of the Army Surgeon General, 2010). The VAS pain scale is inconsistently administered and is regarded as very subjective and had no functional anchors (Office of the Army Surgeon General, 2010). Because of the lack of consistency in tools currently utilized by healthcare professionals, the Department of Defense (DoD) has created a new pain scale in hopes to accurately evaluate pain.

The Defense and Veterans Pain Rating Scale (DVPRS) has been validated and well as shown to be a reliable evaluation instrument in the use of measuring pain in veterans as well as active duty (Nassif, T. H., Hull, A., Brooks-Holliday, S., Sullivan, P., & Sandbrink, F., 2015; Buckenmaier III et al., 2013). The DVPRS take the VAS and the FACES scales and combines them as well as adds additional information. The DVPRS is an 11-point scale ranging from 0-10. This scale uses descriptors under each number, as opposed to every few, or every other number. For example, under number 5 it states, "interrupts pleasurable activities" and under number 8 it states "awful, hard to do anything". In addition to these descriptors, this scale also uses faces, colors ranging from green to red, and an incremental scale to help better assist a patient in evaluating their own pain. Each of these added factors are all supplementary tools to enhance the assessment of pain.

On the back side of the scale are four biopsychosocial questions that help assess how the pain has impacted the past 24 hours. The four questions address general activity, mood, stress, and sleep. These supplemental questions, when combined with the functionally anchored 11-point scale, provides a potentially powerful clinical tool in evaluating a patient's pain, considering treatment goals, and establishing the most appropriate treatment plan (Office of the Army Surgeon General, 2010).

CHAPTER III

METHODOLOGY

Design of investigation

The current study would be best explained as quasi-experimental. Participants were recruited for the study when they entered the athletic training room at their own will, therefore, the researcher did not have control over the participants. Additionally, the current study can be described as single-subject. Because the study does not involve an experimental group and looks at the pre- vs post- treatment of one subject at a time, this is portrayed by the single-subject design.

Participants

The sample of this study was a convenience sample of National Collegiate Athletic Association Division II athletes from California State University, Chico. Exclusionary criteria for the study included: 1) an allergy to cold, 2) hypersensitivity to cold, 3) circulatory or nerve insufficiency, and 4) the injury occurring within the last 24 hours.

There were 20 male and 30 female subjects; 8 men's basketball, 1 men's soccer, 11 men's track and field, 1 softball, 1 volleyball, 2 women's basketball, 11 women's soccer, and 15 women's track and field athletes. After further consideration, 1 male basketball athlete was excluded from the study because he was post-surgical and only undergoing cryotherapy treatment as per physician's instruction.

Table 1 Athlete population

	Female athletes	Male athletes
N	30	20
T&F	15	11
Basketball	2	8
Soccer	11	1
Softball	1	
Volleyball	1	

Treatment

Subjects were recruited for study when they entered the athletic training room seeking a cryotherapy treatment for pain lasting longer than 24 hours. The researcher explained the study and if the subject was willing to participate they were given and signed the informed consent. (Appendix A). Subjects were given the option to undergo the cryotherapy treatment or be a part of a control group, no subjects were willing to be a part of the control group. Subjects who decided to undergo a cryotherapy treatment were then given the Pain Scale Card (Appendix B) and completed a Pre-Treatment Pain Scale (Appendix C). Subjects were then given either an ice bag or the subject immersed the affected area in the cold whirlpool for 20 minutes. Either cryotherapy treatment was chosen by subject according to preference. If treated with an ice bag, the ice bag was placed on the affected area of each subject and secured with FlexiWrap and remained in the athletic training room (ATR) for the 20-minute treatment. The cryotherapy treatment was based on the subjects' preference. As advised by the graduate committee, subjects listed to self-selected music in headphones during entire length of treatment in an effort

to maintain a similar environment for each subject throughout the study. At the conclusion of the treatment, the subjects were given the Pain Scale Card again and filled out a Post-Treatment Pain Scale (Appendix D). This concluded the subjects' participation. The biopsychosocial questions assess the past 24 hours; therefore, the subjects only answered these questions once.

Data analysis procedure

The means of pre- and post-treatment pain scales were calculated and presented, as well as frequency distributions. A Wilcoxon Signed-Ranked Test was used to examine the difference between scores of the pre- and post-treatment pain scales. The various chronic parameters (e.g., general activity) were compared to acute pain to evaluate any possible relationship. These data were analyzed using Spearman rank-order correlation.

CHAPTER IV

RESULTS AND DISCUSSIONS

Presentation of the findings

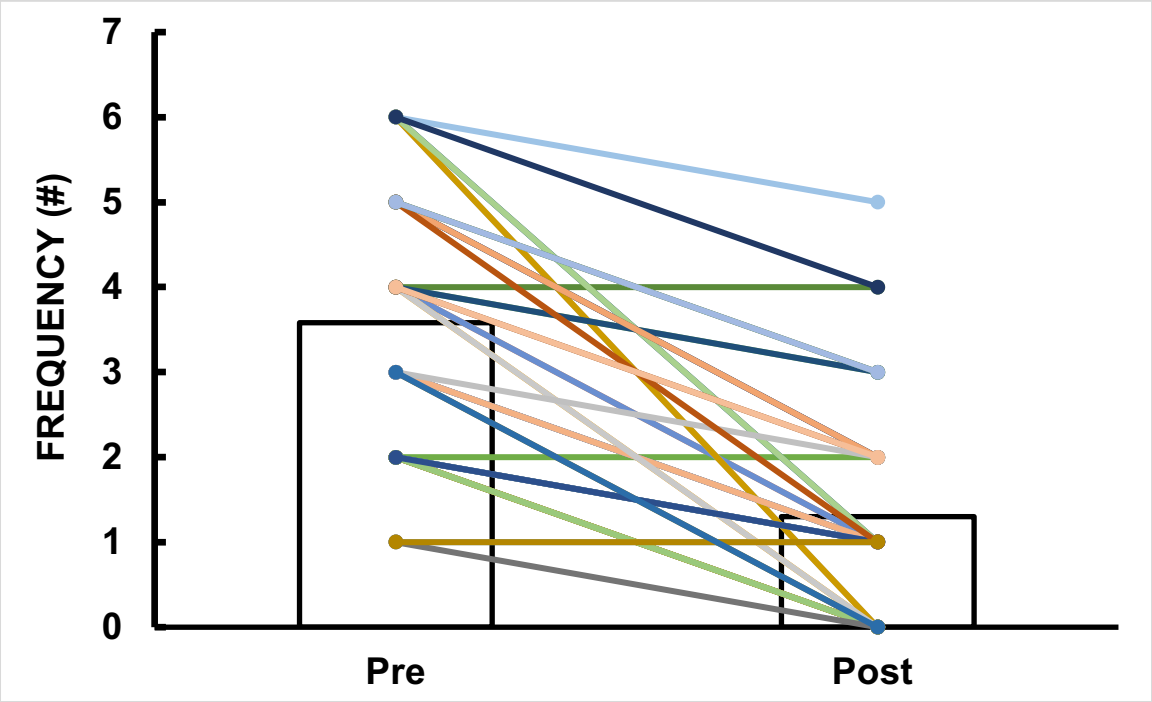

Figure 1. Pre-treatment pain scale to the post-treatment pain scale. The open black-lined bars are the mean for the pre- and post- respectively. This figure clearly shows the average decrease in pain in the subjects before and after the cryotherapy treatment.

Figure 1 shows that overall, there is a statistically significant ($p < 0.05$) decrease in pain after cryotherapy treatment in all subjects. The black bar graphs show the means for the pre- (3.6) as well as the post- (1.3) cryotherapy, as assessed by Wilcoxon Signed-Rank test. The present study used cryotherapy for 20 minutes which disagrees with Long et al. (2005), and Otte et al. (2002), as well as others. Though it has been suggested that health care professionals take into consideration skinfold thickness, and thus, depth of

penetration, the present study used 20 minutes as the standard, and found positive results. This may easily be explained by the subject population was relatively lean. Though no body compositions were assessed, upon visualization of the subjects, it should be noted that none of the subjects carried excessive subcutaneous adipose tissue as, for example, a Division I offensive lineman.

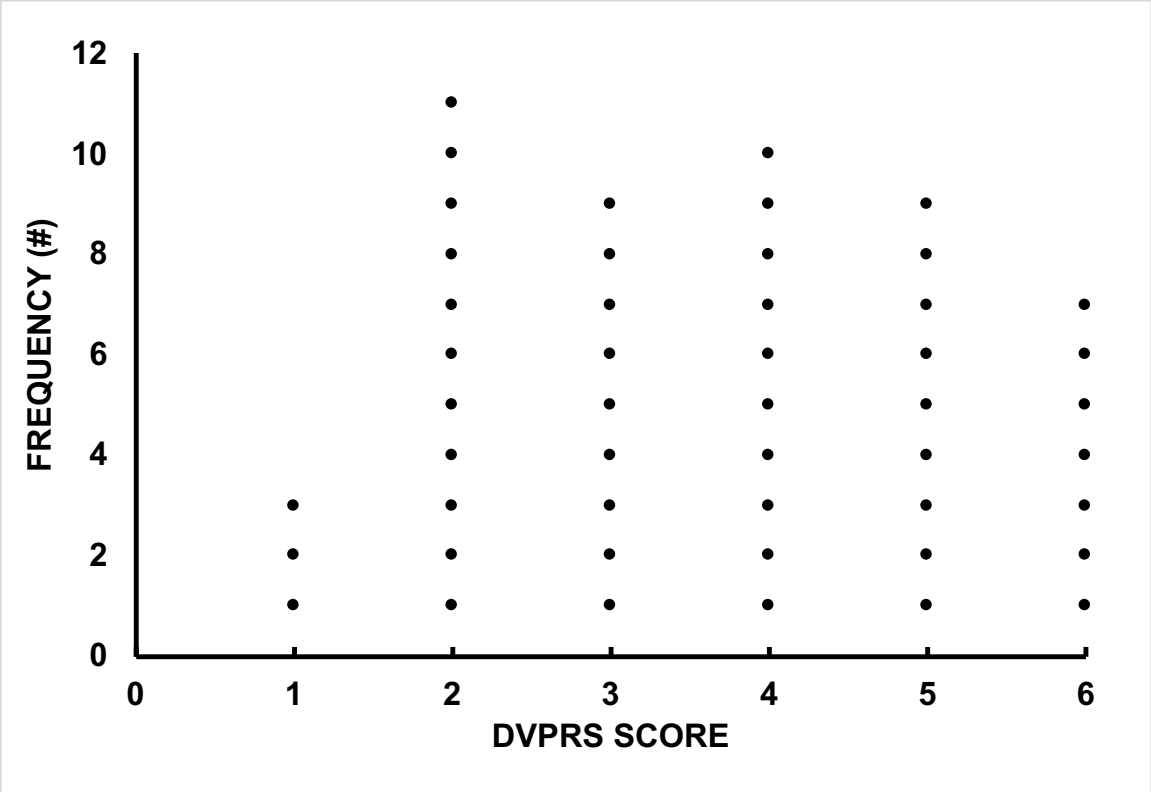

Figure 2. Pre-treatment DVPRS score frequency distribution.

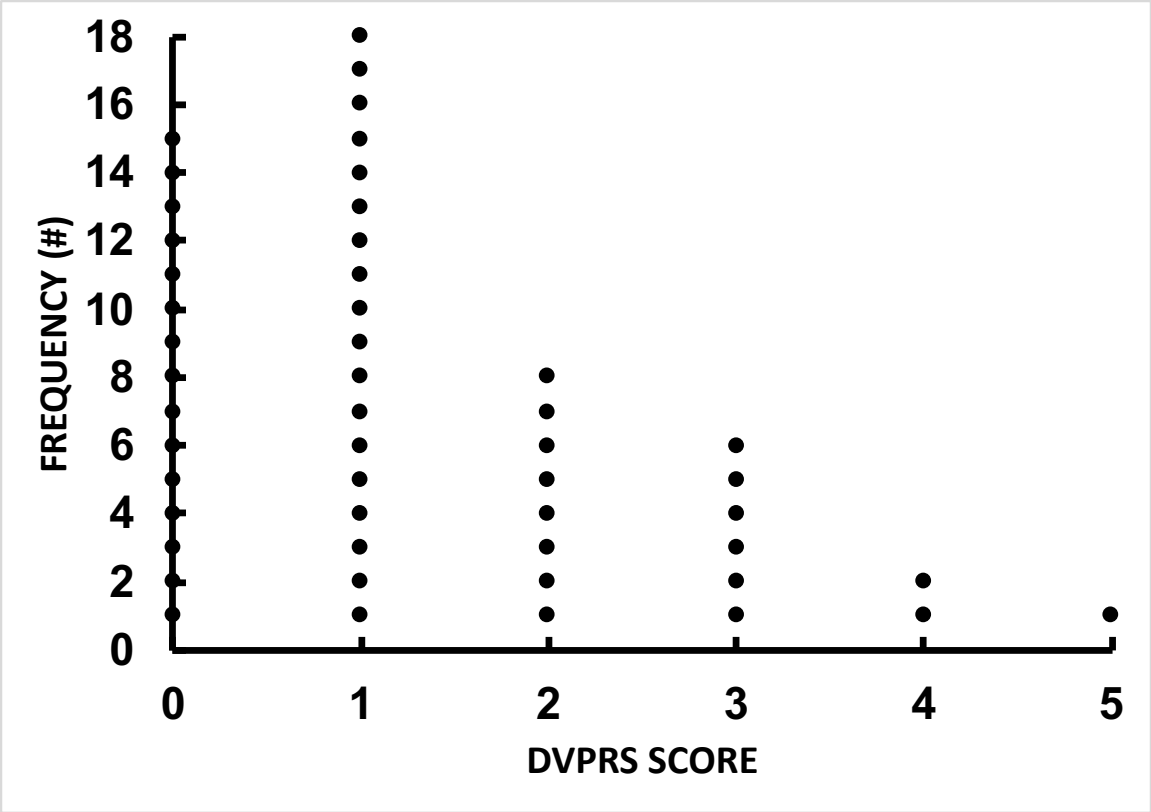

Figure 3. Post-treatment DVPRS score frequency distribution.

The current study utilized Spearman rank-order correlation to measure strength and direction of monotonic association between overall pain and general activity, mood, stress, and sleep in the past 24 hours. The ρ values calculated were 0.991, 0.984, 0.986, and 0.974, respectively, with the population (n) being 49, and α was set was 0.05. This statistically significant Spearman rank-order correlation means that there is less than a 5% chance that the strength of the relationship happened by chance if the null hypothesis were true.

Discussion of findings

The test was run in an excel spreadsheet with the population (n) being 49, α was set was 0.05. The results showed the test statistic is 5 and a two-tailed test is being used,

which makes the critical value 415. With 5 being less than 415 the null hypothesis is rejected. There was a significant decrease in pain following the cryotherapy treatment ($p < 0.05$). This is in agreement with previous work that has shown pain relief with cryotherapy (Cote et al., 1988; Hocutt Jr et al., 1982; Airaksinen et al., 2003). Further, this corresponds with the common findings that cryotherapy is beneficial and explains the high demand of the treatment from athletes, regardless of the effect on edema or tissue temperature, the cryotherapy has been deemed effective because of the significant decrease in pain.

Pre-cryotherapy treatment assessment of pain resulted in a total of 15 athletes ranked their pain between 5 and 6, 19 athletes ranked their pain between 3 and 4, and 14 athletes ranked their pain between 1 and 2 (Figure 2). Whereas in post cryotherapy treatment of pain a total of 3 athletes ranked their pain between 4 and 5, 14 athletes ranked their pain between 3 and 2, and 33 athletes ranked their pain between 1 and 0 (Figure 3). There was a significant shift in the distribution from pre- to post-treatment. It may be concluded that cryotherapy treatment was effective in ameliorating pain.

The biopsychosocial questions are important factors to consider especially when dealing with student-athletes as discussed before. These questions, when combined with the 11-point scale, provide emerging evidence for a tool in evaluating pain and considering treatment goals in athletes. (Office of the Army Surgeon General, 2010). As stated above, the question with the highest correlation coefficient is question 1 assessing general activity. This is a concerning factor, especially for collegiate student-athletes, because when a pain they are having is impacting their general activity is can cause further problems and even cause problems in their classes and studies. This also supports

the fact that health care professionals, athletic trainers specifically, need to be able to properly evaluate and manage pain.

Because of the broad range of injuries that were treated, the researcher did not assess differences among them. The injuries were: ankles-10, gluteal muscle group-1, knees-13, lower back-1, anterior lower leg-13, achilles-2, adductor/hip flexor muscle group-4, foot-1, toe-1, heel-1, quadricep muscle group-1, wrist-1. All injuries were sports related and treated with cryotherapy treatment as stated above. The differences between cold water immersion, ice pack, and ice massaged were not assessed because they are all considered cryotherapy treatments.

In previous work, researchers did not fully investigate the main reason why patients seek medical assistance. Researchers focus on other factors such as swelling, tissue temperature, and depth of penetration (Otte et al. 2002; Long et al. 2005; Sloan et al. 1989; Cote et al.1988; Merrick et al. 1993; Bleakley et al. 2016; Waterman et al. 2012) when in fact none of these matter since the most common reason athletes seek medical care is pain. Additionally, researchers that did assess pain did not use as sensitive an assessment instrument as was used in the present study (Bleakley et al., 2016; Bieri, Reeve, Champion, Addicoat & Ziegler, 1990). Taking pain, function, and biopsychosocial factors into consideration is a crucial part of properly managing pain and should be implemented in every health care profession.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In the medical world, health care professionals pride themselves on providing their patients with the best care possible, this is called "best practice medicine". Athletic trainers, specifically, have continuously grown in their own profession while elevating themselves and providing the best care to their athletes. Unfortunately, there are some practices in the health care profession that are done simply because "that's how it's always been". Cryotherapy is one of those practices. This is not to say that cryotherapy, per se, is a bad practice, rather, there should be sufficient evidence supporting each treatment decision that is being made.

Cryotherapy has been used as a way of treating pain as far back as the time of the Egyptians (~3100 BC) (Bouganim, N., & Freiman, A. 2005). It continues to be the most popular form of traditional pain relief to this day (Bouganim, N., & Freiman, A. 2005). The current study took that in consideration when composing this study. Fifty NCAA DII male and female athletes at California State University, Chico in Chico, California were used as a population for this study. A tool constructed by the DoD was utilized with college athletes to evaluate subjects' pain before and after a cryotherapy treatment to determine if cryotherapy treatment was effective. In order to control the environment, the subjects all remained in the athletic training room for the entire treatment. The results indicated there was a significant decrease in pain when compared before and after the cryotherapy treatment. This current finding from the DoD scale suggests that cryotherapy may effectively reduce subjects' pain.

The current study allowed subjects to listen to self-selected music while icing. However, in the current study, subjects were not listening to music while completing the post-cryotherapy assessment. Thus, the effects of music on the post-cryotherapy assessment are likely negligible, but, should still be considered as a limitation.

Overall, regardless of edema, tissue temperature, or depth of penetration, it has been concluded that cryotherapy is effective in treating pain. The results from this study agree with the initial hypothesis. The significance to take from this study is that the most important factor when treating any patient is the ability to assess and treat pain effectively.

It is recommended that further research continues to build on this study by adding more variables. A cross-over study evaluating pain comparing a cryotherapy treatment to no treatment at all should be conducted. Another recommendation would be to evaluate pain by utilizing other modalities in conjunction with cryotherapy, such as compression. It is my hope this study can be used as a baseline and continued to be built upon and continued by other researchers.

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APPENDIX

APPENDIX A:

Informed Consent for Participation in Research

Project Title: The Effects of Cryotherapy on Pain.

Investigators:

Madalyn Kennedy, ATC, Kinesiology, CSU, Chico

Dr. John Azevedo, Ph.D., Kinesiology, CSU, Chico

Scott Barker, MS, ATC, Kinesiology, CSU, Chico

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You are being invited to participate as a subject in the research project of Madalyn Kennedy, ATC, in the Kinesiology at CSU, Chico. The purpose of this research is to explore cryotherapy is effective in alleviating pain in college athletes. The information gathered from this investigation will allow researchers to deepen the research of care associated with alleviating pain. There will not be a specific benefit to the individual participant.

If you indicate a willingness to participate in the study, you will be asked to do the following things:

1. Read Pain Scale Card (attached)
2. Fill out a Pre-Pain Scale (attached)
    - Information Gathered
        - Sport
        - Gender
        - Affected Area
3. Treatment group assigned by desire from participant
    - Treatment
        - Ice treatment for 20 minutes
    - No treatment
        - No treatment for 20 minutes
4. Remain in Athletic Training Room for the entire time of treatment
5. Read Pain Scale Card
6. Fill out Post-Pain Scale (attached)

Potential Risks involved with this study:

- **If you have an allergy, hypersensitivity, or circulatory or nerve insufficiency do not participate in this study**

- Feeling of cold, burning, aching, and numbness of affected area
- Decreased nerve sensation
- Frostbite
- It is unlikely that you will get injured during your participation in this study; however, in case of an unanticipated injury, emergency personnel will be contacted. Neither the researchers nor CSU, Chico is responsible for any injury that may occur during the course of your participation in this study

Reports resulting from this study will not identify you as a participant. All information gathered in this study will remain confidential and be given out only with your permission or as required by law. If you give us permission by signing this consent form, we will protect your confidentiality. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of randomly assigning each participant a number and then randomly assigning each number to either Group A or Group B. Data gathered from this study will be shared with the researchers at California State University, Chico, as well as the California State University, Chico community. There is a possibility this study will be published but any identifying information will remain confidential.

If you have any questions about the research, you may contact Madalyn Kennedy at (760) 885-8641 or at mkennedy34@mail.csuchico.edu. If you have questions regarding your rights as a research participant, please contact Sharron Cain at the CSU, Chico Human Subjects in Research Committee at 530-898-3145 or irb@csuchico.edu.

Please feel free to contact any one of the investigators if you have any questions or concerns about this research project or your participation. Your participation is voluntary. You may choose to stop your participation in the study at any time during the testing session. Your decision will be respected and will not result in any penalty. Having read the above and have had an opportunity to ask any questions please sign below if you would like to participate in this research. A copy of this form will be given to you to retain for future reference.

_____

Participant Name (Please Print)

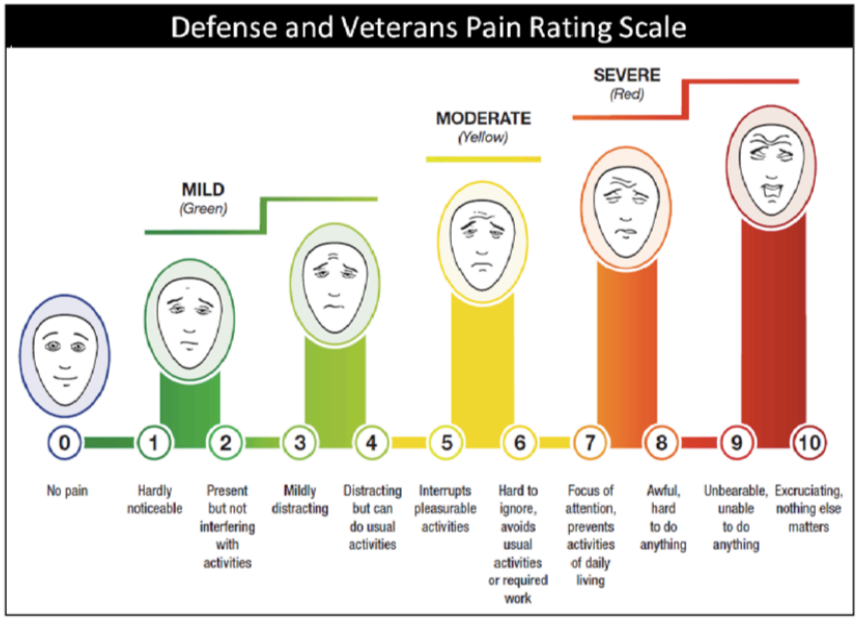
_____ _____

Participant Signature Date

_____ _____

Researcher Signature Date

APPENDIX B:



Defense and Veterans Pain Supplemental Questions

For clinicians to evaluate the biopsychosocial impact of pain

1. Circle the one number that describes how, during the past 24 hours, pain has interfered with your General Activity:

0 — 1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10

Does not interfere — Completely interferes

2. Circle the one number that describes how, during the past 24 hours, pain has affected your Mood:

0 — 1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10

Does not interfere — Completely interferes

3. What is your Level Of Stress related to pain in the past 24 hours?

0 — 1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10

Does not interfere — Completely interferes

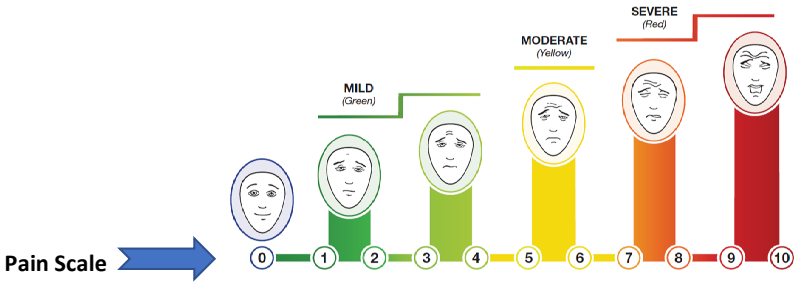
4. Circle the one number that describes how, during the past 24 hours, pain has affected your Sleep:

0 — 1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10

Does not interfere — Completely interferes

APPENDIX C:
PRE-TREATMENT

Gender: _____ Sport: _____ Body Part: _____



1. General Activity:	0	1	2	3	4	5	6	7	8	9	10
2. Mood	0	1	2	3	4	5	6	7	8	9	10
3. Level of Stress	0	1	2	3	4	5	6	7	8	9	10
4. Sleep	0	1	2	3	4	5	6	7	8	9	10

APPENDIX D:
POST-TREATMENT

Gender: _____ Sport: _____ Body Part: _____