8-2023

# Effects of Static Versus Dynamic Cupping on Ankle Dorsiflexion

Alexandria N. Schaub
*Northern Michigan University*, alschaub@nmu.edu

# EFFECTS OF STATIC VERSUS DYNAMIC CUPPING ON ANKLE DORSIFLEXION

By

Alexandria Nicole Schaub

THESIS

Submitted to
Northern Michigan University
In partial fulfillment of the requirements
For the degree of

MASTER OF EXERCISE SCIENCE

College of Graduate Studies and Research

August 2023

ABSTRACT

EFFECTS OF STATIC VERSUS DYNAMIC CUPPING ON ANKLE DORSIFLEXION

By

Alexandria Nicole Schaub

**PURPOSE**: Originating from traditional Chinese medicine, cupping therapy involves lifting and separating fascial tissue to facilitate stretching and promote blood flow. Although cupping is a common treatment modality for pain, various protocols exist and studies are inconsistent in regards to whether cupping improves other outcomes, like range of motion. Possessing a limited range of motion can lead to musculoskeletal injury. Thus, here is a need to understand whether cupping improves range of motion and whether different types of cupping result in differing outcomes. The aim of this research is to determine the acute effect of different methods of cupping therapy on ankle dorsiflexion. **METHODS**: A total of 35 generally healthy adults (age: 22.1±4.52 years) with an average ankle ROM of 34.68±4.22° at baseline were included in the study. Participants were randomly assigned to one of four cupping therapy groups: static cupping, dynamic cupping, static sham cupping, or dynamic sham cupping. Ankle ROM was measured using a validated method pre- and immediately post-intervention. The minimal detectable change (MDC) for weight bearing ankle dorsiflexion was calculated based on the reliability of baseline measurements at 4.96º. A 2x4 mixed ANOVA was used to determine whether ankle ROM differed between groups pre-to-post treatment. **RESULTS**: All groups showed an immediate improvement in ankle ROM post-intervention (38.41±4.95º), but there was no significant interaction effect between intervention and time ($F(3,31)=1.31$, $p=.289$). However, a significant main effect of time was observed($F(1,31)=33.69$, $p<0.001$, partial $\eta^2 = .52$), indicating an overall increase in ankle ROM regardless of the intervention received. The dynamic cupping group experienced a clinically significant change in ankle ROM (pre ROM=

34.11±4.62°, post ROM= 39.19±6.44°) above the MDC (5.08°), while the other groups did not reach this threshold. **CONCLUSION:** These findings support the potential of cupping as a modality for improving ankle ROM in individuals with limited ROM. Dynamic cupping may be more effective than static cupping for improving ankle ROM due to the addition of functional movement, so clinicians and researchers can consider dynamic cupping as a potential intervention to address limited ankle ROM and its associated complications.

SIGNATURE APPROVAL FORM

Thesis Title:
Effects of Static Versus Dynamic Cupping on Ankle Dorsiflexion

This thesis by Alexandria Schaub is recommended for approval by the student's Thesis Committee and Department Head in the Department of Health and Human Performance and by the Dean of Graduate Studies and Research.

_____ _____
Committee Chair: Megan Nelson Ph.D. Date

_____ _____
First Reader: Julie Rochester Ed.D. Date

_____ _____
Second Reader (if required): Kari Getschow M.S. Date

_____ _____
Department Head: Elizabeth Wuorinen Ph.D. Date

_____ _____
Dr. Lisa Schade Eckert Date
Dean of Graduate Studies and Research

# ACKNOWLEDGMENTS

I would like to start by thanking my thesis director, Dr. Megan Nelson, for all of her extensive advice, support, and dedication throughout the entire process. I would also like to thank the rest of my thesis committee, Dr. Julie Rochester and Kari Getschow, for all of their help and always having an open-door policy. Without the aid of these people, this thesis could not have been completed.

The cost associated with the research conducted in this project has been underwritten by the Excellence in Education grant provided by Northern Michigan University.

This thesis follows the format prescribed by the American Medical Association (AMA) Manual of Style, 11th edition and the Department of English.

TABLE OF CONTENTS

LIST OF TABLES…….…….....VII

LIST OF FIGURES…….……...VIII

INTRODUCTION ……..1

CHAPTER 1: CUPPING THERAPY …….……...4

Types of Dry Cupping …….…….…….…….5

Outcomes Associated with Dry Cupping Therapy…….……6

Hypothesized Underlying Mechanisms of Action of Dry Cupping Therapy ...…….…..…….11

Limitations and Future Research Directions……...……...……...…....14

REFERENCES…….....17

CHAPTER 2: MANUSCRIPT …….20

Participants …….…….…21

Study Design.…. ……22

Protocol ……....22

Statistical Analysis…….……...24

Results ……..……25

Discussion…….……28

Limitations ……...33

Conclusion ……...……...……34

CHAPTER 3: FUTURE DIRECTIONS…….…..……36

REFERENCES …….…….……..37

APPENDIX A: STUDY DOCUMENTS ……...…….41

LIST OF TABLES

Table 1: Descriptive Statistics ……...…26

Table 2: Average ROM Pre to Post by Group……28

LIST OF FIGURES

Figure 1: Average Cupping ROM Pre and Post Intervention…….26

Figure 2, a-d: Participants pre to post ankle ROM…….28

# INTRODUCTION

Myofascial decompression therapy, also referred to as cupping, is a type of manual therapy often used as an alternative approach for reducing pain, inflammation, or improving range of motion (ROM) at specific areas of the human body. Dry cupping involves placing a dome-shaped cup over an area of skin and then creating a negative pressure within the cup, either through direct application of heat or through an air pump device. It is hypothesized that cupping grabs and lifts the fascia, allowing for lymphatic drainage of toxins and facilitating stretching of the tissue.[1] This in turn, is thought to increase blood flow and ROM, promote cellular healing, and decrease inflammation and tension in the fascial and muscle tissue.[2]

Cupping has taken off in popularity due to high profile athletes bearing circular-shaped cup markings/bruises on their backs.[3] Additionally, the application process is relatively easy and the equipment needed to perform cupping is affordable. Two types of dry cupping have been identified as the most commonly used techniques, which include static cupping and dynamic cupping. Static cupping therapy involves cups being applied in one place for a period of time while a patient remains still and relaxed the entire time the cups are attached to the skin.[4] Dynamic cupping therapy involves cups being placed on a specific area of the body while the patient is asked to move a particular body part through a full ROM.[1] Static cupping is the most commonly used method of dry cupping with most research conducted with this technique, with only limited research available on dynamic cupping.[3] Additionally, there are no studies that were found that have compared the effects of static and dynamic cupping on ankle ROM and have also included sham cupping therapy to assess the possibility of a placebo effect.

There is low-quality evidence to suggest dry cupping is effective for reducing chronic neck and back pain, however, it is unclear whether range of motion (ROM) is affected.[5]

Possessing a limited ROM at any particular joint is a common risk factor for musculoskeletal injuries such as strains and myofascial restrictions.[6] Specifically, limited ankle ROM can be caused by tightness or lack of flexibility in the gastrocnemius muscle in the calf. Clinicians have reported that even in healthy subjects, the loss of ankle dorsiflexion ROM may result in compensatory hindfoot pronation with subsequent anterior knee joint pain due to altered patellofemoral tracking,[7] implying that a lack of ankle ROM can alter a patient's gait and lead to other musculoskeletal issues such as knee pain. The alteration of gait may lead to musculoskeletal injuries or limitations from poor walking or running mechanics.[8] Additionally, limited ankle dorsiflexion has been shown to lead to a higher risk of injury in groups such as runners, leading to injuries like plantar fasciitis or medial tibial stress syndrome.[7] Identifying effective modalities, such as cupping, to improve ankle dorsiflexion may be one approach for decreasing injuries associated with poor flexibility and limited ROM. Thus, there is a need to understand whether cupping is a technique that can improve ROM and whether different types of cupping are more beneficial than others.

The use of sham cupping is also a relatively new addition when assessing both pain and ROM.[4,9–11] Although a pilot study developing the placebo report an effective blinding of participants, more research is needed in validating the effectiveness of sham cupping.[12] Patient reported outcome measures is an approach to aid in the development of the effectiveness in sham cupping by asking questions about the effect of the cupping modality, and the perceived effect of the treatment.[13]

The aim of this study is to address these gaps in the literature by investigating the immediate effects of two different types of cupping (dynamic and static) on ankle range of motion, and to also include sham therapies, which will strengthen the research design by adding

‘active’ control groups and allow for blinding of participants to the therapy they received. This will account for any placebo effect that may be occurring during either the dynamic or static cupping therapy. We expect that the dynamic cupping group will have the most improvements in ankle flexibility measured by ankle dorsiflexion ROM, compared to all of the other therapy groups.

# CHAPTER ONE: CUPPING THERAPY

Myofascial decompression therapy (MFD), also known as cupping therapy, has been used in traditional medicinal practices dating back 2,000 years in ancient China.[1] The practice of wet cupping was first used in ancient Chinese medicine and is still associated with alternative medicine today, involves making a small incision and placing a cup on top of the skin to draw blood[8]. Traditionally, wet cupping is a therapeutic approach that is believed to combat illness and promote well-being.[14] Although wet cupping is not typically used in western medicine practices, dry cupping therapy—cupping without creating lesions in the skin—has gained popularity recently because the media depicted well-known swimmers like Michael Phelps in the 2016 Olympic games with circular cupping marks on their backs.[3] Dry cupping involves placing a dome-shaped cup over an area of skin and then creating a negative pressure within the cup, either through direct application of heat or through an air pump device[8] with the goal of pain reduction, inflammation reduction, or an increase in flexibility and ROM. It is hypothesized that cupping grabs and lifts the fascia, allowing for lymphatic drainage of toxins and facilitating stretching of the tissue.[1] This in turn, is thought to increase blood flow and range of motion (ROM), promote cellular healing, and decrease tension in the fascial and muscle tissue.[2] Medical professionals such as physical therapists, athletic trainers, and other sports medicine professionals can take certification classes in order to get trained and informed on the treatment and procedures of cupping.

Although there is growing evidence of the benefits of dry cupping therapy, many questions exist regarding the underlying mechanisms of dry cupping therapy (e.g., whether there

are actual physiological benefits or if patients experience benefits via placebo effect) and which protocols (e.g., amount of negative pressure, length of duration of cups on the skin, static or dynamic procedure) can elicit beneficial outcomes. The purpose of this review is to synthesize the published literature on dry cupping; in particular, define dry cupping and the different types, summarize the hypothesized underlying mechanisms of dry cupping therapy and its associated outcomes and patient interaction reports, and finally identify the gaps in the literature.

**Types of dry cupping**

Dry cupping is a non-invasive procedure classified as a manual therapy that consists of the use of cups, typically made out of plastic (the most common), glass, silicone, or bamboo, placed over specific areas of skin. Vacuum suction is applied using different techniques such as heat from a flame or manual or electrical pumps to create a negative pressure and draw skin and soft tissue into the cup.[5] Different sized cups may be used depending on the local area of the procedure, and are typically placed on the skin with the use of a medium, such as lotion or ultrasound gel for comfort. The cups are then left on the skin for anywhere between 5 to 15 minutes, typically while the patient remains still and relaxed, depending on the type of cupping being used.[8,15] Common sites for cupping include, low back, upper trapezius/shoulder, and hamstrings in order to reduce pain or to improve flexibility and ROM in the affected area.[5]

There are multiple dry cupping techniques, with the most common being static and dynamic cupping. Static cupping therapy involves cups being applied in one place for a period of time while a patient remains still and relaxed the entire time the cups are attached to the skin. Static cupping is the most commonly used dry cupping technique due to the ease and straightforwardness of the application process. As such, the majority of dry cupping research uses a static cupping technique.[4]

Dynamic cupping therapy involves cups being placed on a specific area of the body while the patient is asked to move that particular body part through a full ROM. The dynamic cupping technique is a more recent development with few research studies conducted on its effectiveness.[16] Since this technique is relatively new, there are disputed names for dynamic cupping. Other researchers have identified dynamic cupping as the application of a negative pressure cup to the skin followed by moving the cup across the surface of the skin.[6,17] This technique can also be called "scanning" and for the purpose of this literature review, it will continue to be referred to as scanning and is a separate technique from dynamic cupping. Dynamic cupping is used in a similar way as Active Release Technique (ART). ART is performed by applying deep tension over tender tissues while the patient actively moves the tissue from a shortened to a lengthened position, thereby breaking up the fascial adhesions.[18] ART has been shown to decrease pain and dysfunction in low back patients, improving pelvic tilt and pelvic rotation, and hamstring ROM.[19,20] Dynamic cupping uses a similar technique, but instead of applying compressive forces over tender tissue, it uses decompressive tension with the use of a cup to complete a "pinning" effect. Dynamic cupping can be described as more painful compared to static cupping due to the patient actively contracting the muscle being restricted, but is still within an acceptable comfort zone.

**Outcomes associated with dry cupping therapy**

Cupping is proposed to have many effects including but not limited to: pain reduction, inflammation reduction, and the promotion of flexibility and ROM in an affected area. Research demonstrates that pain reduction and ROM changes are the most common outcomes resulting from cupping treatment[6], and there are many hypotheses as to why cupping may affect pain and ROM.

**Cupping therapy and pain reduction.** The majority of research has investigated the effects of dry cupping therapy as a modality for pain reduction in the neck and back. There is low-quality evidence to suggest dry cupping is effective for reducing chronic neck and back pain, primarily due to lack of control groups and poor study designs.[1] A systematic review that aimed to investigate the effects of dry cupping therapy for individuals with chronic pain concluded that there was moderate-quality evidence to support cupping is more efficacious compared to no treatment or other treatments (e.g., heat therapy, usual care, and conventional medications) for reducing pain in individuals with chronic neck and back pain over the short-term (e.g., treatments over the span of two to three weeks).[22] Another systematic review similarly found evidence for dry cupping and reduction of non-specific neck pain when compared to no treatment, based on five clinical trials with a total of 249 participants with chronic neck pain. The result of all five trials was that there was a statistically significant reduction of pain in individual who received cupping therapy (e.g., static cupping and moving cupping).[4,25,26,27] However, due to inconsistency and imprecision within the five trials (e.g., differences in time the cups were placed on the skin, lack of control groups/sham groups), the researchers concluded there was low-quality evidence supporting the use of dry cupping for chronic neck pain.[4] Additionally, across two trials with 196 participants that met inclusion criteria for low-back pain (clinically diagnosed with chronic low back pain with no neurological diagnosis), a meta-analysis was conducted to determine the combined acute effects of cupping therapy on low-back pain and it was found that there was a significant effect of dry cupping on low-back pain when compared to minimal care, medication, and control groups.[4,23,24] Due to the inconsistency of the findings (e.g., difference in treatment time, type of cupping, and sample size), researchers concluded that the quality of evidence was low for dry cupping on low-back pain relief. More recent studies that

have investigated the relationship between cupping and pain reduction over the short-term support Cao et al. (2014), including other areas of the body such as the hamstrings and calves.[1,2,6,8,16] Although individuals may have reduced pain in the short-term as a result of cupping therapy, to understand the long-term effect of cupping on chronic pain, more studies are needed that follow up with participants longitudinally rather than only after two to three weeks.

One additional study was found that investigated the effect of cupping on muscle tenderness in the gastrocnemius that included the use of a placebo group. Twenty college-aged participants were randomized into a cupping intervention or placebo group; one cup was placed on participants' right calf 10 cm superior to the musculotendinous junction of the Achilles tendon and the gastrocnemius muscle.[10] The cup was then suctioned two full pumps and left on the skin for a total of 15 minutes. Again, the only difference between the sham and actual cups was a small hole in the top of the cup so that negative pressure would release during the treatment.[10] This study shows that sham cupping is possible along the calf muscle however, and shows that more research is needed in ROM with the calf. Overall, the quality of evidence to support the use of dry cupping therapy for pain reduction is low, but several individual research studies do indicate significant decreases in pain levels for both neck pain and low-back pain for individuals aged 18 to 60 years with chronic neck and low back, and more research needed with other muscle groups in order to fully determine the effectiveness of dry cupping on pain. Developing specific protocols clinicians can follow for each area/muscle group may increase the quality of evidence needed in order to determine if cupping is an appropriate modality for pain.

**Cupping therapy and range of motion and mobility.** Possessing a limited ROM at any particular joint is a common risk factor for musculoskeletal injuries such as strains and myofascial restrictions.[6] Fascial restrictions are one possible cause of limited flexibility and often

form in response to inactivity, injury, inflammation, or disease. With a decrease in fascial elasticity, fascia can bind around the affected areas, causing a fibrous adhesion to form. Such fibrous adhesions have been shown to be painful, decrease overall soft tissue extensibility, and prevent normal muscle mechanics with restrictions to joint range of motion and muscle length.[6] It is unclear whether cupping effects ROM and how cupping compares to modalities known to improve ROM, such as foam rolling.[5]

A systematic review and meta-analysis on cupping and its effects on pain and cervical and lumbar ROM, consisting of three clinical trials for a total of 126 participants found that when compared to an active control group (e.g., traditional physical therapy, passive stretching, and active stretching), dry static cupping had no statistically significant effect on improving ROM in both the low-back and cervical spine.[5,28,29] This may be due to inconsistencies in the length of treatment, size of the cups, or sample size of each study. One pilot study aimed to investigate the immediate effects of dynamic cupping on hamstring flexibility in 17 collegiate athletes with a diagnosed hamstring pathology (mild strain and/or symptoms of tightness, pain, decreased strength, and decreased flexibility).[1] The cupping consisted of the researchers placing six plastic cups along the hamstring for 3 minutes followed by active mobilization that consisted of 10 repetitions of full-range active knee flexion and 10 repetitions of passive straight leg raises with the cups still in place. It was found that cupping resulted in a significant increase in hamstring ROM ($t = –3.74$, $p= 0.01$) with a 4.42º increase when compared to an active control group using a foam roller ($t =–1.44$, $p = 0.19$) with 3.68º increase.[1] Another study also used a similar dynamic cupping procedure to determine the effects of dry cupping on pain and functionality in the gastrocnemius.[16] 71 participants with plantar fasciitis were randomized into two groups, with both groups completing foot and ankle exercises and the intervention group

receiving cupping after completing the exercises. The cupping group had one cup placed over a trigger point on the calf for 5 minutes, and then completed ankle dorsiflexion exercises. The cups were left on the gastrocnemius for an additional 3 minutes for a total therapy duration of 10 minutes.[16] The result was improved ROM in both the cupping and active control groups ($p<.001$), with slightly greater improvements in the cupping group. However, it should be noted that the results of these studies should be interpreted with caution, as there were major limitations, specifically, a lack of blinding of subjects to treatments, which can lead to a high risk of performance bias.

Three studies were identified that utilized a placebo, or sham cupping group in their study design in order to eliminate bias.[4,9,10] One observed the difference between sham and cupping on trunk flexion in 90 participants (aged 18 to 59) with low-back pain. Trunk flexion was measured pre and post, and cups were placed bilaterally along the L1 to L5 vertebrae for 10 minutes, with the only difference between the sham and cupping groups being a small hole drilled into the tops of the sham cups to allow for negative pressure to decrease. The result was that there was no statistical difference in trunk flexion between the sham and actual intervention groups (intervention=14.1 ± 11.1cm, control=11.6 ±10.6cm). Another study investigated the effects of cupping on hamstring ROM using a crossover study design in a sample of 25 participants (age 23.52 ± 3.50 years, male n=19, female n=16) with limited hamstring ROM. Participants received each of the three treatments (sham, cupping, and control) in a random order. The treatments consisted of participants lying prone with cups placed on their hamstring passively for 10 minutes; participants returned two more times to receive the remaining two treatments. For the control treatment, participants followed the same exact procedure, but with no cups attached to their hamstring. Hamstring ROM was measured at baseline, immediately post-intervention, and

10 minutes post-intervention with a straight leg raise test. The results indicated there was no significant change in hamstring ROM between any of the groups from baseline (control: 66.83±10.63°; sham: 67.08±13.95°; cupping: 69.08±11.36°) to post-intervention (control: 67.57±12.67°; sham: 66.51±14.68°; cupping: 70.88±12.64°) or at 10 minutes post-intervention control: 66.47±13.21°; sham: 67.05±15.52°; cupping: 70.40±12.62°).[4]

**Hypothesized underlying mechanisms of action of dry cupping therapy**

Cupping therapy likely induces various outcomes due to several different underlying mechanisms. Although there is a multitude of differing research about the differing mechanisms, there are a few mechanisms and hypothesis that are most commonly discussed, including the physiological effects of the pressure lifting and separating the layers of tissue to provide more adequate blood flow to the area,[3] the idea of pain gait theory intercepting the pain receptors with the use of the cups,[21] as well as the placebo effect taking place and changing the participants perception of the treatment.[31]

**Improved blood flow and vasodilation.** The negative pressure within the cup elicits a petechia, or ecchymosis response in the body which looks and heals similarly to a bruise over the course of 7-14 days.[3] The redness and/or bullae formation and histological changes in the skin at the localized area that proceeds a cupping session may be due to vasodilation and edema without actual cellular infiltrate.[3] In the cupped region, blood vessels are dilated by the action of certain vasodilators such as adenosine, noradrenaline and histamine, and some researchers propose that the main action of cupping therapy is to enhance the circulation of blood and to remove toxins and waste from the body due to these vasodilation effects.[21]

**Pain-gate theory.** Other researchers suggest that the cups act as a stimulus in conjunction with the “pain-gate theory”, which is one of the most well-known theories of pain reduction. The

pain-gate theory describes how pain is transmitted from the point of its inception to the brain, and how it is processed in the brain which sends back the efferent, protective signal to the stimulated or injured area.[21] Cupping has been hypothesized to influence chronic pain by altering signal processing at the level of the nociceptors–sensory receptors that respond to painful stimuli–both of the spinal cord and brain.[21] Taken together, this theory can help explain why pain is reduced and ROM increases in cupping patients by essentially overwhelming the pain receptors into closing the pain gate receptors and leading to pain reduction or improvements in ROM.

**Placebo effect.** The placebo effect may also help to explain why cupping results in decreased pain and increased ROM in many individuals.[13,30] Placebo effects are dependent on the perceptions and expectations that exist within an individual receiving the treatment, such that when a sham treatment is given, an individual still experiences a therapeutic benefit.[31] For example, some therapeutic modalities, such as taping or compression sleeves, may induce beneficial changes to an individual but do not have clear data supporting or denying the hypothesized physiological mechanism underlying the effect. However, if the individual perceives the modality will work, even if there is no therapeutic value, the individual will still feel better after receiving the treatment. Cupping may be a modality that has a similar result, as there is evidence that patient-reported outcomes improve or physiological outcomes are no different when compared to a sham treatment.

A recent study investigated the effects of dry cupping on pain, physical function, functional mobility, trunk ROM, perceived overall effect, quality of life, psychological symptoms, and medication use in n=90 adults aged 18-59 years with chronic, non-specific low back pain using a two-arm, randomized controlled trial with blinded participants and outcome

assessment. Participants were randomized into either a sham (n=45) or dry cupping (n=45) group, and the respective treatments consisted of placing 4 cups on specific locations of the lower back, administering 2 pumps to create a negative pressure, and leaving the cups on the skin for 10 minutes.[32] Participants received one session per week over 8 weeks (8 sessions total).The sham group received negative pressure within the cups but <2 mm holes were present in the cups so that negative pressure within the cups dissipated within 3 seconds. It was found that participants in both the dry cupping and sham groups reported similar reductions in lower back pain intensity after session one, session 4 and session 8. Additionally, there were no clinically meaningful effects from cupping among any of the other outcomes measured in the study. Because this study found that participants experienced similar reductions in pain regardless of whether they received sham or dry cupping over the 8 sessions, the authors suggest it is unlikely improvements were due to negative pressure within the cups. Alternatively, the authors suggest that any improvement in clinical outcomes after cupping are due to the placebo effect, positive expectations regarding cupping, natural recovery and regression to the mean, therapeutic alliance, and environmental context.

For example, 24 participants with chronic low back pain were recruited to receive dry cupping in either a sham or intervention group on their low back. In general, patients (either in sham or real group) reported the experience and benefits in the dimension of pain were satisfactory and recommendable.[13] This can possibly be attributed to many factors, including the patient-therapist relationship, having sensation expectations created before treatment by the clinician, as well as how comfortable the room is (i.e. temperature of the room, coziness of the positioning).[13] Perceived outcome effects are rarely measured specifically on ROM. Warren et al. used the global rating of change scale (GROC) to determine the patient reported outcome of

their hamstring cupping.[1] Results showed that the participants in the cupping group rated their hamstring ROM has improving on average a "moderate amount" which was statistically different compared to the foam rolling group. Identifying effective modalities, such as cupping, to improve ankle dorsiflexion as well as their perceived effect may be one approach for decreasing injuries associated with poor flexibility and limited ROM.

**Limitations and future research directions**

Limited ankle ROM can be caused by tightness or lack of flexibility in the gastrocnemius muscle in the calf. Clinicians have reported that even in healthy subjects, the loss of ankle dorsiflexion ROM may result in compensatory hindfoot pronation with subsequent anterior knee joint pain due to altered patellofemoral tracking,[7] implying that a lack of ankle ROM can alter a patient's gait. The alteration of gait may lead to musculoskeletal injuries or limitations from poor walking or running mechanics.[8] Additionally, limited ankle dorsiflexion has been shown to lead to a higher risk of injury in groups such as runners, leading to injuries like plantar fasciitis or medial tibial stress syndrome.[7] Identifying effective modalities, such as cupping, to improve ankle dorsiflexion may be one approach for decreasing injuries associated with poor flexibility and limited ROM.

Since dynamic cupping is a relatively new method, many studies have not yet been conducted observing the effects of dynamic cupping. The current studies that have been conducted using dynamic cupping are inconsistent with the placement of cups, the amount of time the cups are left on the skin, and a defined measurement protocol. As such, it is difficult to determine the effectiveness of the dynamic cupping method without developing a consistent technique and precise way to measure the outcomes.

Although one study did look at the effects of dynamic cupping on gastrocnemius and ankle dorsiflexion, it did not involve the use of a sham cupping device to eliminate bias.[16] Sham cupping is a vital group needed in order to validate the use of cupping. Similar to many modality methods, there is potential that the placebo effect is taking place and is skewing results due to this effect. Controlling for this is crucial in understanding the effects of cupping, both statically and dynamically. Only two studies were found with the use of sham cupping devices to help prevent this bias. However, both of these studies were measuring effects solely on static cupping and not dynamic.[4,9] Additionally, there are no studies that were found that have compared the effects of static and dynamic cupping on ankle ROM and have also included sham cupping therapy to assess the possibility of a placebo effect. Most studies involve hamstring ROM and low back pain/ROM so expanding measurements to other areas of the body that are commonly associated with poor ROM and injuries is necessary to expand the knowledge of what areas cupping can be beneficial to. Only one study was found with sham cupping on the calf, but ROM was not a measurable factor.[10]

Measurement of the blinding success of the placebo groups is also crucial to understanding the perceived effect of cupping. Three studies were identified that reported the outcome of the blinding, with two reporting success and one failure.[11] Since using patient outcome measurements is also key in understanding the effects of cupping on range of motion, determining if the sham cupping technique is successful or not is needed. A perceived effect scale has been shown to be accurate in determining the patient's perceived effect of the cupping, as well as including questions asking participants if they believed they received either an intervention treatment or a placebo treatment.[11,13] Including all of these components is key to understanding the effectiveness of dry cupping.

We are proposing to determine the acute effect of different styles of cupping therapy (static, dynamic, static sham, dynamic sham) on ankle dorsiflexion in healthy adults. It is hypothesized that dynamic cupping will have more of an effect on ankle dorsiflexion compared to static cupping as well as sham cupping groups, and for patient satisfaction to be reported as high.

REFERENCES


1. Warren AJ, LaCross Z, Volberding JL, O'Brien MS. Acute Outcomes Of Myofascial Decompression (Cupping Therapy) Compared To Self-myofascial Release on Hamstring Pathology After a Single Treatment. Intl J Sports Phys Ther. 2020;15(4):579-592. doi:10.26603/ijspt20200579
2. Klecan K. The Use of Dry Cupping with Active Movement to Increase Functional Mobility and Decrease Pain in a Patient with Cervical Disc Disorder: A Case Report.
3. Lowe DT. Cupping therapy: An analysis of the effects of suction on skin and the possible influence on human health. Complementary Therapies in Clinical Practice. 2017;29:162-168. doi:10.1016/j.ctcp.2017.09.008
4. Schafer MD, Tom JC, Girouard TJ, Turner CL, Radzak KN. Cupping Therapy Does Not Influence Healthy Adult's Hamstring Range of Motion Compared to Control or Sham Conditions. Published online 2020:9.
5. Wood S, Fryer G, Tan LLF, Cleary C. Dry cupping for musculoskeletal pain and range of motion: A systematic review and meta-analysis. Journal of Bodywork and Movement Therapies. 2020;24(4):503-518. doi:10.1016/j.jbmt.2020.06.024
6. Xie J. The Effects of Static Versus Dynamic Myofascial Decompression on Hamstring Flexibility In a College-Aged Population: A Pilot Study.
7. Youdas JW, Krause DA, Egan KS, Therneau TM, Laskowski ER. The Effect of Static Stretching of the Calf Muscle-Tendon Unit on Active Ankle Dorsiflexion Range of Motion. J Orthop Sports Phys Ther. 2003;33(7):408-417. doi:10.2519/jospt.2003.33.7.408
8. Murray D, Clarkson C. Effects of moving cupping therapy on hip and knee range of movement and knee flexion power: a preliminary investigation. Journal of Manual & Manipulative Therapy. 2019;27(5):287-294. doi:10.1080/10669817.2019.1600892
9. Almeida Silva HJ, Barbosa GM, Scattone Silva R, et al. Dry cupping therapy is not superior to sham cupping to improve clinical outcomes in people with non-specific chronic low back pain: a randomised trial. Journal of Physiotherapy. 2021;67(2):132-139. doi:10.1016/j.jphys.2021.02.013
10. Cage A, Trail L, Galbraith R, Cox C, Warner B. Effect of Cupping Therapy on Muscle Tenderness in Collegiate Baseball Players Compared to Sham Treatment: A Randomized, Single-Blinded Trial. JSMAHS. 2023;8(4). doi:10.25035/jsmahs.08.04.01
11. Aboushanab T, Qoqandi M, Basalom S. Active sham cupping therapy technique: identification of limitations and suggesting enhancements. TMR Non-Drug Ther. 2022;5(4):20. doi:10.53388/TMRND20221027020
12. Lee MS, Kim J-I, Kong JC, Lee D-H, Shin B-C. Developing and Validating a Sham Cupping Device. Acupuncture in Medicine. 2010;28(4):200-204. doi:10.1136/aim.2010.002329
13. Almeida Silva HJ, Avila MA, Castro KMS, et al. Exploring patient experiences of participating in a real and sham dry cupping intervention for nonspecific low back pain: A qualitative study. Özden F, ed. PLoS ONE. 2022;17(5):e0268656. doi:10.1371/journal.pone.0268656

14. Almaiman AA. Proteomic effects of wet cupping (Al-hijamah). SMJ. 2018;39(1):10-16. doi:10.15537/smj.2018.1.21212
15. Kim JE, Cho JE, Do KS, Lim SY, Kim HJ, Yim JE. Effect of Cupping Therapy on Range of Motion, Pain Threshold, and Muscle Activity of the Hamstring Muscle Compared to Passive Stretching. KSPM. 2017;12(3):23-32. doi:10.13066/kspm.2017.12.3.23
16. AlKhadhrawi N, Alshami A. Effects of myofascial trigger point dry cupping on pain and function in patients with plantar heel pain: A randomized controlled trial. Journal of Bodywork and Movement Therapies. 2019;23(3):532-538. doi:10.1016/j.jbmt.2019.05.016
17. Cobb S, Maddox O, Seitz G, Arnot C. The Effects of Stretching versus Static and Dynamic Cupping on Lumbar Range of Motion: A Randomized Control Trial. 2022;34(1):8.
18. Barnes P, Rivera M. The Effect of Active Release Technique® on Clinician and Patient-Reported Outcomes: A Systematic Review. Journal of Sport Rehabilitation. Published online 2021:1-6. doi:10.1123/jsr.2021-0106
19. Gaur VV, Kapoor AA, Phansopkar PA. Short Term Effects of Muscle Energy Technique vs. Active Release Technique in Improving Hamstring Flexibility and Pain in Patients with Acute Anterior Cruciate Ligament (ACL) Tear - A Randomized Control Trial. jemds. 2021;10(3):137-142. doi:10.14260/jemds/2021/29
20. Lee SH, Nam SM. Effects of Active Release Technique on Pain, Oswestry Disability Index and Pelvic Asymmetry in Chronic Low Back Pain Patients. KSPM. 2020;15(1):133-141. doi:10.13066/kspm.2020.15.1.133
21. Al-Bedah AMN, Elsubai IS, Qureshi NA, et al. The medical perspective of cupping therapy: Effects and mechanisms of action. Journal of Traditional and Complementary Medicine. 2019;9(2):90-97. doi:10.1016/j.jtcme.2018.03.003
22. Cao H, Li X, Yan X, Wang NS, Bensoussan A, Liu J. Cupping therapy for acute and chronic pain management: a systematic review of randomized clinical trials. Journal of Traditional Chinese Medical Sciences. 2014;1(1):49-61. doi:10.1016/j.jtcms.2014.11.00323.
23. Teut, M., Ullmann, A., Ortiz, M., Rotter, G., Binting, S., Cree, M., Lotz, F., Roll, S., Brinkhaus, B., 2018. Pulsatile dry cupping in chronic low back pain - a randomized three-armed controlled clinical trial. BMC Compl. Alternative Med. 18 (115) https://doi.org/10.1186/s12906-018-2187-8.
24. Akbarzadeh, M., Ghaemmaghami, M., Yazdanpanahi, Z., Zare, N., Azizi, A., Mohagheghzadeh, A., 2014. The effect dry cupping therapy at acupoint BL23 on the intensity of postpartum low back pain in primiparous women based on two types of questionnaires, 2012; A randomized clinical trial. Int. J. Community.Base Nurs.Midwifery 2 (2), 112e120. Retrieved from: https://www.ncbi.nlm.nih. gov/pmc/articles/PMC4201191/.
25. Cramer, H., Lauche, R., Hohmann, C., Choi, K.E., Rampp, T., Musial, F., Langhorst, J., Dobos, G., 2011. Randomized controlled trial of pulsating cupping (pneumatic pulsation therapy) for chronic neck pain. Forsch Komplementmed 18 (6), 327e334. https://doi.org/10.1159/000335294.
26. Saha, F.J., Schumann, S., Cramer, H., Hohmann, C., Choi, K.E., Rolke, R., Langhorts, J., Rampp, T., Lauche, R., 2017. The effects of cupping massage in patients with chronic

neck pain - a randomised controlled trial. Complementary Med.Res. 24, 26e32. https://doi.org/10.1159/000454872.
27. Lauche, R., Cramer, H., Choi, K.E., Rampp, T., Saha, F.J., Dobos, G.J., Musial, F., 2011. The influence of a series of five dry cupping treatments on pain and mechanical thresholds in patients with chronic non-specific neck pain-a randomised controlled pilot study. BMC Compl. Alternative Med. 11 (63), 1e11. https://doi.org/10.1186/1472-6882-11-63.
28. El Rahim, A.A.A., ELkabalawy, M.A., Al-Din Hassan, A.S., Atta, H.K., 2017. Cupping therapy versus interferential cupping therapy on mechanical low back pain. Int. J.ChemTech. Res. 10 (2), 253e264. Retrieved from. http://www.sphinxsai.com/ 2017/ch_vol10_no2/1/(253-264)V10N2CT.pdf.
29. Yim, J., Park, J., Kim, H., Woo, J., Joo, S., Lee, S., Song, J., 2017. Comparison of the effects of muscle stretching exercises and cupping therapy on pain thresholds, cervical range of motion and angle: a cross-over study. Phys. Ther.Rehabil. Sci. 6 (2), 83e89. https://doi.org/10.14474/ptrs.2017.6.2.83.
30. Hammons D, McCullough M. The Effect of Dry Cupping on Gastrocnemius Muscle Stiffness, Range of Motion and Pain Perception After Delayed Onset Muscle Soreness.
31. Sliwinski J., Elkins G., 2013. Enhancing Placebo Effects: Insights From Social Psychology, American Journal of Clinical Hypnosis, 55:3, 236-248, DOI: 10.1080/00029157.2012.740434
32. Silva HJ de A, Saragiotto BT, Silva RS, Lins CA de A, de Souza MC. Dry cupping in the treatment of individuals with non-specific chronic low back pain: a protocol for a placebo-controlled, randomised, double-blind study. BMJ Open. 2019;9(12):e032416. doi:10.1136/bmjopen-2019-032416

## CHAPTER 2: MANUSCRIPT

Myofascial decompression therapy, also referred to as cupping, is a type of manual therapy often used as an alternative approach for reducing pain, inflammation, or improving range of motion (ROM) at specific areas of the human body. Dry cupping involves placing a dome-shaped cup over an area of skin and then creating a negative pressure within the cup, either through direct application of heat or through an air pump device. It is hypothesized that cupping grabs and lifts the fascia, allowing for lymphatic drainage of toxins and facilitating stretching of the tissue.[2] This in turn, is thought to increase blood flow and ROM, promote cellular healing, and decrease inflammation and tension in the fascial and muscle tissue.[3]

Cupping has taken off in popularity due to high profile athletes bearing circular-shaped cup markings/bruises on their backs.[4] Additionally, the application process is relatively easy and the equipment needed to perform cupping is affordable. Two types of dry cupping have been identified as the most commonly used techniques, which include static cupping and dynamic cupping. Static cupping therapy involves cups being applied to a specific area of the body (e.g., back, hamstring, gastrocnemius), for a period of time while a patient remains still and relaxed the entire time the cups are attached to the skin.[5] Dynamic cupping therapy involves a similar cup placement, but the patient is asked to move a particular body part through a full ROM while negative pressure persists in the cups, rather than lie still and relaxed.[2] Static cupping is the most commonly used method of dry cupping with most research conducted using this technique; limited research exists on the use of dynamic cupping protocols.[4] To our knowledge, we are unaware of any studies that compared the effects of both static and dynamic cupping on ankle ROM and also included a sham cupping therapy as a means to blind participants and assess the possibility of a placebo effect.

There is low-quality evidence to suggest dry cupping is effective for reducing chronic neck and back pain acutely,[6] however, it is unclear whether range of motion (ROM) is affected.[6] Possessing a limited ROM at any particular joint is a common risk factor for musculoskeletal injuries such as strains and myofascial restrictions.[5] Specifically, limited ankle ROM can be caused by tightness or lack of flexibility in the gastrocnemius muscle in the calf. Clinicians have reported that even in healthy subjects, the loss of ankle dorsiflexion ROM may result in compensatory hindfoot pronation with subsequent anterior knee joint pain due to altered patellofemoral tracking,[16] implying that a lack of ankle ROM can alter a patient's gait. The alteration of gait may lead to musculoskeletal injuries or limitations from poor walking or running mechanics.[17] Identifying effective modalities, such as cupping, to improve ankle ROM may be one approach for decreasing injuries associated with poor flexibility and limited ROM. Thus, there is a need to understand whether cupping is a technique that can improve ankle ROM and how different types of cupping compare to each other in their ability to affect ankle ROM.

The aim of this study was to investigate the immediate effects of two different types of cupping (i.e., static and dynamic) on ankle ROM, while including sham therapies to serve as active control groups and allow for blinding of participants to the therapy they received. We hypothesized that the dynamic cupping group would have the most improvements in ankle ROM measured via the modified lunge technique for weight bearing dorsiflexion, compared to all of the other therapy groups.

**Participants**

Thirty-five generally healthy adults aged 18 years and older that did not have any previous history of cupping experience, lower extremity injury over the past 6 months, or any

contraindications associated with cupping therapy (e.g., deep vein thrombosis, pregnancy, bone fracture, sunburn/rash) were recruited. Exclusion criteria also included participants with normal levels of weight bearing dorsiflexion (≥40°).[14] Participants were recruited by word of mouth and by putting up flyers around the Northern Michigan University campus and city of Marquette.

**Study Design**

A parallel group design with both within-subject (pre and post) and between-subject (treatment) factors was used to compare the acute effect of cupping therapy on ankle dorsiflexion. Participants received one of four cupping interventions, which they were blinded to. The four different intervention groups consisted of: two types of cupping therapy, static cupping and dynamic cupping, and two types of sham therapy, sham static cupping and sham dynamic cupping. The sham therapies were utilized in this study as an attempt to investigate the placebo effect from either static or dynamic cupping therapy, as the underlying mechanisms related to the effect of cupping therapy on ROM and other outcomes lack strong evidence.

**Protocol**

This study was approved by the Institutional Review Board (IRB) for ethical considerations. After completing a pre-screening questionnaire to ensure study inclusion criteria is met, participants were asked to come to the Athletic Training Clinic on the Northern Michigan University campus to participate in one 45-minute study visit. All participants signed an informed consent form explaining all aspects of the study prior to taking part in any study procedures. Participants were then randomly assigned to one of the four intervention groups and blinded to the intervention they were selected to receive. Survey information including basic

demographics (e.g., age, sex, race/ethnicity) and health history was collected, followed by anthropometric measurements. Height was measured to the nearest 0.1 cm as the average of two measurements using a stadiometer. Weight was measured with a calibrated digital scale to the nearest 0.1 kg.

Weight bearing ankle dorsiflexion, the main outcome of the study, was measured pre-intervention and immediately post-intervention using a validated digital inclinometer (URPRO digital inclinometer) that records to the nearest degree, which has been shown to have high reliability when used to measure ankle ROM.[7] Participants were placed into a modified lunge position and asked to bring their knee forward without allowing their heel to come off the ground with the digital inclinometer placed vertically over the tibial tuberosity.[8] Measurements were taken three times and the average of the three measurements, recorded to the nearest degree, was reported as the ankle ROM. The same researcher measured ankle ROM for all of the participants.

Regardless of the therapy received (sham vs. cupping therapy), all participants had four cups placed on their left gastrocnemius totaling 10 minutes in duration. Specifically, all participants were asked to lie prone on an exam table while two cups were placed one-inch inferior to the medial and lateral heads of the gastrocnemius; and the remaining two placed four inches inferior to the initial cups, at approximately the middle of the muscle belly of the gastrocnemius. A trained researcher, who was a certified athletic trainer with 3 years of utilizing cupping in clinical practice performed all cupping treatments in the study. The cups used in this study were plastic and measured two inches in diameter (Kangzhu, Beijing, China). Negative pressure was created inside all of the cups by drawing out air with two full pumps via a manual suction tool (Kangzhu, Beijing, China), similar to other cupping studies.[10,11] For participants randomized into a sham therapy group, a small pin-sized hole in the cups was created to provide

the feeling of suction but relieve the cup of negative pressure throughout the 10-minute intervention. Adhesive tape was used to prevent the cups from detaching from the gastrocnemius for participants receiving sham therapy, however, the tape was placed on all participants to ensure blinding was not revealed.

After the four cups were placed on the gastrocnemius, participants randomly assigned to the static cupping groups (i.e., sham or actual therapy) were asked to remain still in the prone position for a total of 10 minutes. For those randomly assigned to the dynamic cupping groups, participants remained still in the prone position for the first 5 minutes of the protocol. After 5 minutes passed, participants were asked to complete two sets of 10 full range ankle pumps with a rest period of 30 seconds between sets (approximately 2 minutes). For the remaining 3 minutes of the dynamic cupping protocol, the participants were asked again to lie still. Ankle ROM was measured again immediately post-intervention in all participants using the same procedure as the pre-intervention measurement.

**Statistical Analyses**

Descriptive statistics are reported as mean ± standard deviation (SD) or n (%) for continuous and categorical variables, respectively. Data was visually inspected for outliers and to determine whether parametric assumptions were met using histograms, residual plots, and box-and-whisker plots. Intrarater reliability was quantified by calculating the intraclass correlation coefficient ($ICC_{(3,1)}$) for the three ankle ROM measurements at baseline, using a two-way mixed effects model and absolute agreement.

One-way ANOVAs were used to determine whether differences existed for ankle ROM and descriptive characteristics between the groups at baseline. The main analysis to determine the acute effect of the cupping interventions on ankle ROM pre-to-post treatment was conducted

by using a 4x2 (intervention by time) mixed ANOVA. Statistical differences were defined as $p<.05$. Partial eta-squared ($\eta^2$) effect sizes were calculated and interpreted as: small effect=.01, medium effect=.06, and large effect=.14. All statistical analyses were conducted using IBM Statistical Package for the Social Sciences for Windows version 29.0 (SPSS Inc., Chicago, IL, USA). Finally, the minimal detectable change (MDC) for ankle ROM, or smallest real change outside of measurement error for ankle ROM, was calculated with the following formula: MDC = $1.96 \cdot \sqrt{(2)} \cdot$ SEM, where SEM = standard error of the measurement (SEM = SD $\cdot \sqrt{(1-r)}$, where *r* is the ICC reliability parameter).

Sample size was estimated *a priori* for a within-between-subjects interaction design using G*Power.[15] To detect a difference in ankle ROM between the four groups, we used an effect size of .49 that was calculated using the results from Schaefer et al. (2020). To reject the null hypothesis with a probability (power) of .08 and $\alpha = .05$, the calculation indicated n=35 participants were required.

## Results

***Sample characteristics.*** In total, we recruited n=49 volunteers, but n=14 were deemed ineligible to participate due possessing to great of ROM at the ankle (i.e., weight-bearing dorsiflexion ≥40°). A total of n=35 participants were eligible and completed the study. The sample consisted of young (age: 22.1±4.52 y), generally healthy adults (65.7% women, n=23; height: 169.9±7.71 cm, weight: 73.18±18.66 kg) with an average ankle ROM of 34.68±4.22° at baseline, which is below the criteria for a normal level of weight bearing dorsiflexion. Additionally, there were no differences between height, weight, and age between groups ($p>.05$

for all); however, the dynamic sham group included significantly more women compared to men. The participant characteristics for each group are displayed in Table 1.

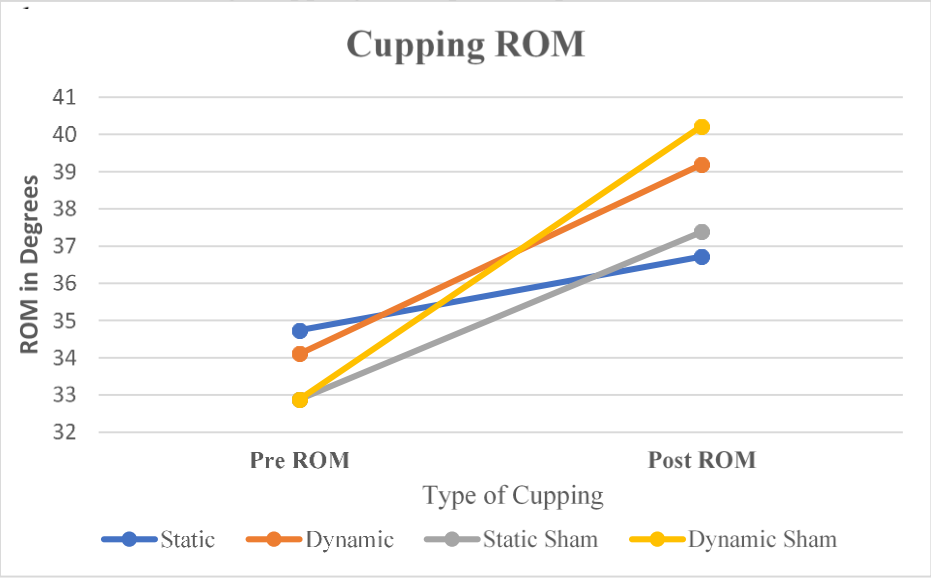
**Table 1.** *Descriptive statistics*

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| **Group** | **Male(n)** | **Female(n)** | **Age(y)** | **Height(cm)** | **Weight(kg)** |
| Static | 4 | 4 | 23.22±7.12 | 168.5±8.56 | 71.94±14.94 |
| Dynamic | 4 | 5 | 22.55±4.06 | 165.17±4.66 | 71.98±26.5 |
| Static Sham | 4 | 5 | 21.37±2.33 | 172.56±5.92 | 81.35±19.19 |
| Dynamic Sham | 0 | 9 | 21.22±3.42 | 173.74±8.71 | 68.38±11.69 |

***Ankle range of motion.*** Average ankle ROM at baseline was not different between the four groups $F(3,31)=1.31$, p=.289. Reliability for baseline ankle ROM measurements was good $ICC_{(3,1)}$(absolute error)=.87, (95% confidence interval: .78-.93). Using this value for the MCD calculation, it was determined the MDC for weight bearing ankle dorsiflexion was 4.96°.

There was no statistically significant intervention by time interaction effect for ankle ROM, $F(3,31)=1.13$, p=.35, partial $\eta^2= .098$. On average, all groups appeared to experience an immediate improvement in ankle ROM, pre to post intervention (Figure 1; Table 2).

**Figure 1.** *Average cupping ROM pre and post intervention*



There was a statistically significant main effect of time for ankle ROM, $F(1,31)=33.69$, $p<0.001$, partial $\eta^2 = .52$. Regardless of the intervention received, average ankle ROM increased immediately after the intervention (38.41±4.95º) compared to ankle ROM at baseline (34.68±4.22º). Of the 35 participants in the study, four experienced a decrease in ankle ROM whereas the remaining 31 experienced an increase (Figure 2a-d). Three participants who experienced a decrease in ankle ROM were in the placebo groups, and the other participant who also experienced a decrease in ankle ROM was in the dynamic cupping group (Figure 2b-d). When comparing the change in ankle ROM for each of the groups to the MCD, the dynamic cupping group experienced a clinically significant change in ankle ROM above the MCD (5.08°). Participants in the static, static sham, and dynamic sham cupping groups did not experiences changes above the MDC, on average (1.98°, 4.49°, 3.45°, respectively).

**Figure 2, a-d.** *Participants pre to post ankle ROM*

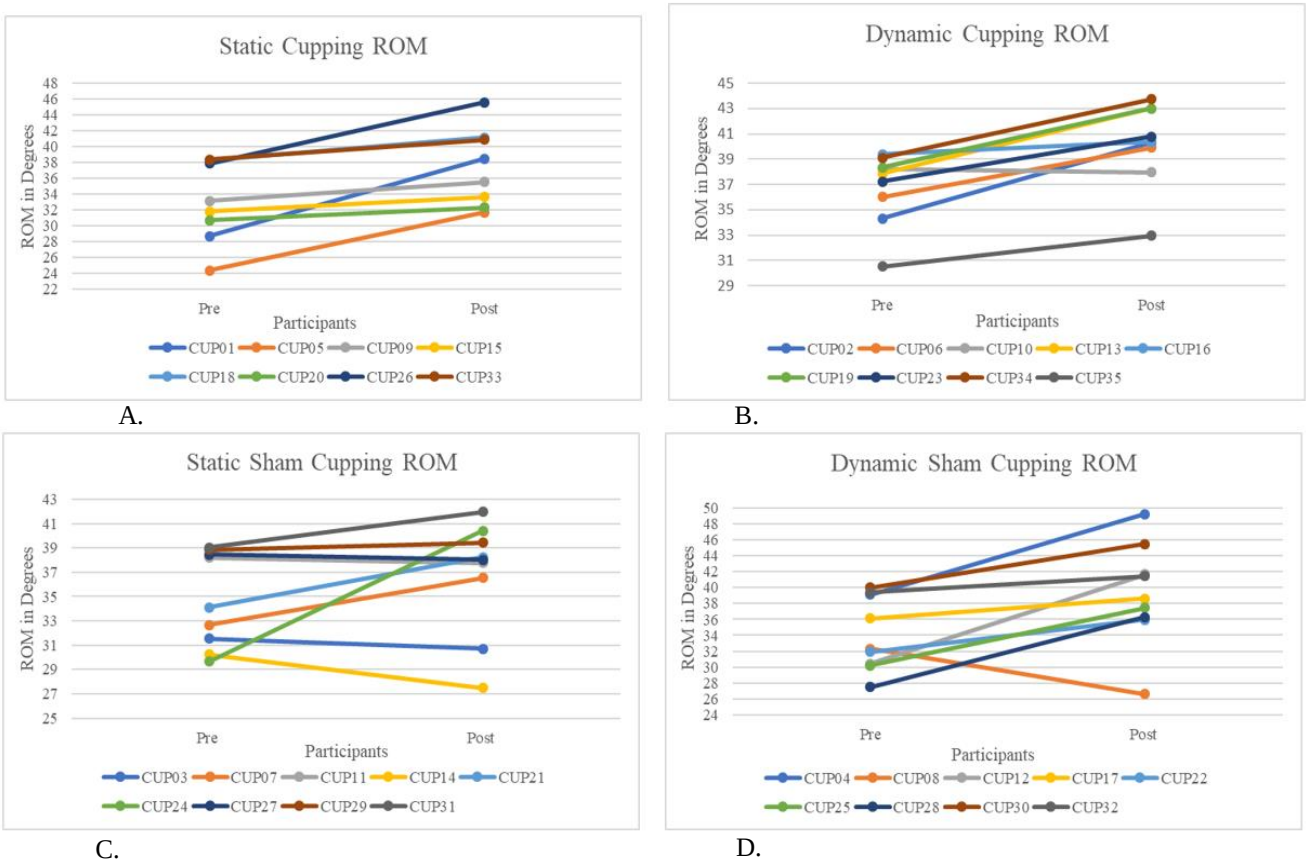



**Table 2.** *Average ROM pre to post by group*

| Type of Cupping | Pre ROM | Post ROM |
|---|---|---|
| Static | 34.74±3.92° | 36.72±4.68° |
| Dynamic | 34.11±4.62° | 39.19±6.44° |
| Static Sham | 32.89±5.06° | 37.38±4.92° |
| Dynamic Sham | 36.77±2.83° | 40.22±3.28° |

## Discussion

The purpose of our study was to examine the acute effects of different types of cupping protocols on ankle ROM, when compared to sham cupping. We found that on average, there was a statistically significant improvement in ankle ROM immediately after treatment, regardless of whether participants were allocated to a sham or actual cupping treatment. However, participants

in the dynamic cupping therapy group experienced a change in ankle ROM above the MDC of 4.96° whereas participants in the static, static sham, and dynamic sham groups experienced changes in ankle ROM below the minimal detectable change, indicating the dynamic cupping group experienced the only clinically significant change. Our novel findings suggest dynamic cupping may result in acute changes to ankle ROM in generally healthy, young adults who have an ankle dorsiflexion range <40°.

Although there was no statistically significant interaction effect to indicate the change in ankle ROM was different between the four different types of cupping interventions (i.e., static, dynamic, static sham, and dynamic sham), we found there was a significant main effect of time, suggesting that participants who received any of the four interventions significantly improved their ankle ROM pre-to-post treatment. Our findings are somewhat consistent with other studies that examined the acute effect of dry cupping on ankle ROM.[1,12] Hammons and McCullough (2022) investigated the effect of static cupping on muscle stiffness, active dorsiflexion and perceived pain after the completion of an exercise protocol designed to induce delayed-onset muscle soreness in the lower legs in n=20 physically active, generally healthy men and women. Participants underwent a 5-minute static cupping treatment where cups were placed on the medial gastrocnemius of the dominant leg. The non-dominant leg was used as a control and rested for the 5 minutes. All study outcomes were measured at baseline, pre-treatment, post-treatment, and 5 minutes post-treatment. It was found that active dorsiflexion was improved post-treatment (pre-ROM: 15.1°±4.5º, post-ROM: 16.8°±4.7º) and 5 minutes post treatment (17.4°±4.5º) in the dominant leg that received the cupping treatment, but not the non-dominant resting leg (pre-ROM: 14.1°±3.9º, post-ROM: 14.0°±4.3º, 5-min post-ROM: 15.0°±4.8º). Although Hammons (2022) reported excellent reliability, along with statistically significant

changes and large effect sizes for ankle ROM after the cupping intervention, the absolute change was small (range: 1.7-2.3°) which may not indicate a clinically significant change occurred. Hammons (2022) also did not exclude participants with prior cupping experience, thus, the changes experienced in ankle ROM could have been influenced by previous perceptions of cupping. Additionally, using the resting leg as a control removes the ability of the researchers to employ blinding in the experiment (i.e., participants knew their dominant leg received real treatment while their non-dominant leg did not), which could have also impacted the findings. In our study, we found that although there was an improvement in participants who received the static cupping treatment, this improvement was not above the MDC threshold and thus, not likely clinically significant. AlKhadhrawi et. al (2019) used trigger points on the calf to place one cup on a tender area, and used a dynamic cupping technique after 5 minutes of static cupping, with the use of ankle pumps to reduce tenderness and to increase ankle dorsiflexion similar to our study, against an active control group of self-stretching, in participants with plantar fascia pain (n=71). The main difference in the dynamic cupping protocol of AlKhadharwi et al.'s study compared to ours was the number of cups placed on the calf (one compared to four). The results of this study showed an increase in ROM in both the dynamic cupping group (n=36, pre-ROM=40°, post-ROM=45°), as well as the active control group (n=35, pre ROM=41°, post ROM=44°).[12] However, the increase in ROM in the intervention group was statistically significant, whereas, in the control group it was not. The magnitude of change in ankle ROM in this study is comparable to the change experienced by our dynamic cupping group. Additionally, in both AlKhadhrawi et al. and our study, ankle ROM improved in the treatment and active control group, which both involved movement at the ankle, suggesting that the use of movement may have been important for participants' increase in ankle ROM regardless of the group.

The group that improved the most in our study was the dynamic cupping group, implying that the use of the functional movement of the gastrocnemius (i.e., the ankle pumps), may be a useful strategy to employ during a cupping treatment for improving weight bearing dorsiflexion. Participants in the dynamic cupping group in our study were the only ones, on average, to exceed the calculated MDC for ankle ROM of 4.96°, with a change of 5.08°. The MDC indicates the smallest amount change that is needed in order to see a clinical, or functional change in the affected area, above the level of measurement error. Although we found that the pre-to-post intervention changes in ankle ROM between the four cupping groups were not statistically different, the findings that they dynamic cupping group experienced the largest changes to ankle ROM exceeding the MDC suggest dynamic cupping may be relevant in a clinical setting.[19] Having participants actively move a muscle through a full ROM at the same time a negative pressure is applied to the muscle from the cups may produce a similar effect as proprioceptive neuromuscular facilitation (PNF) stretching. PNF stretching involves a holding an isometric muscle contraction, followed by full relaxation of the same muscle, which results in an improvement to ROM at the targeted area. The PNF contraction-relaxation technique has been found to help individuals gain more neuromuscular control, which in turn increases ROM.[13] Having the participants actively contract and relax their ankle, while either the real or sham cups are placed on their calf, may in turn be increasing their neuromuscular control similarly to that of PNF stretching.

Dynamic cupping is also similar to Active Release Technique (ART). ART is performed by applying deep tension over tender tissues while the patient actively moves the tissue from a shortened to a lengthened position, thereby breaking up the fascial adhesions.[22] ART has been shown to decrease pain and dysfunction in low back patients, improving pelvic tilt and pelvic

rotation, and hamstring ROM.[23] Dynamic cupping uses a similar technique, but instead of applying compressive forces over tender tissue, it uses decompressive tension with the use of a cup to complete a "pinning" effect. Since these techniques both involve the use of active movement with the use of a force over a tender area of the muscle, this may explain why the dynamic cupping group showed clinically significant improvement as well.

Participants who received sham cupping in our study also showed a slight increase in ankle ROM compared to baseline when measured immediately after their treatment. When compared to other studies that included a sham group, our findings were similar when ROM was the outcome.[10] Silva et al. (2021) concluded that in participants with chronic low-back pain (n=90), static cupping was not superior to sham cupping on trunk ROM. Trunk ROM was measured pre- and post-intervention after eight weeks of static cupping therapy (10-minutes per session, once per week). There was no between-group difference in the intervention and sham cupping groups, with only a 1 cm difference in trunk ROM post-treatment, which was not statistically significant.[10] Since there is no clinical difference between static and sham cupping in either group regardless on if the participant felt the negative pressure of the cups, is likely that any clinical improvements observed after static cupping are a consequence of the placebo.[10] Since this study used only static cupping, this may explain why our dynamic cupping group had a greater increase in ROM than that of the static group, regardless of the placebo effect. There may be reason to use dynamic cupping with movement in order to improve ROM, rather than static cupping, which is solely based on the physiological effects from the negative pressure in the cups, and has been shown to have similar results to sham groups.

Although not reported in the present manuscript, we attempted to follow up with participants at the conclusion of data collection to ask whether they perceived the treatment they

received to be beneficial using the following questions: “In this study, the participants were split up into either intervention groups or placebo groups. Based on your experience immediately after the cupping, do you believe you were in the placebo group or the intervention group? Why do you think you were in that group?”.[20] Additionally, we asked participants to complete a Global Perceived Effect survey to measure the perceived effect cupping had on each subject.[24] We expected the surveys to reveal that regardless of the cupping treatment received, the blinding of participants was successful, and that participants would report high satisfaction with ankle ROM improvement. Since this questionnaire was added at the end of the participant recruitment and data collection and required follow up with the participants, the response rate was low (37%; n=13 respondents). Of the 13 respondents, six participants stated they felt “much improvement”, six stated “a little improvement”, and one stated “a little deterioration”. Overall, the majority of participants felt that the study intervention improved their ankle ROM, regardless of the intervention received. Silva et al. (2022) reported similar findings, with the majority of the participants stating positive feedback from their cupping experience, regardless of real intervention or sham group placement.[20] Out of the 13 participants who completed the questionnaire, 10 believed they were in the intervention group (n=7 in an intervention group, n=3 in a placebo group), with three believing they were in one of the placebo groups. Of those three, only one was actually in the placebo group. Our findings indicate regardless of the physiological mechanism underlying the effects of cupping therapy, cupping therapy of any kind may provide beneficial outcomes to ankle ROM immediately after treatment in individuals that have a limited ROM.

**Limitations**

This study was accompanied by several limitations throughout the data collection process. Data collection began in August of 2022, however, many more participants than anticipated were excluded from the study due to their ankle ROM being too high for inclusion in the study. Our criteria for ankle ROM was that participants must have less than 40 degrees of weight bearing dorsiflexion to qualify for the study, as normal dorsiflexion is defined as 40 degrees and above.[8] We would not expect to see many changes, if any, in ankle ROM in participants whom already possess an ankle ROM within the normative values for weight bearing dorsiflexion, as they would not have much to gain. Approximately 49 participants had entered the study and been assessed for ankle dorsiflexion, with only 35 participants meeting inclusion criteria for ankle dorsiflexion. Additionally, although we achieved a sample size large enough to detect a statistically significant difference, larger studies should be done to fully understand the effects of dynamic cupping on ankle ROM and its usefulness as a modality for improving ankle ROM, in a variety of different individuals.

Our study design itself also presents limitations. Although we believe our study design was strong to include two sham/placebo cupping treatments, we did not use a true control group of participants that received no form of cupping at all. The use of a true control group would have eliminated our ability to fully blind participants, as some participants would obviously know they were in a control group because they would have not received any cups placed on the skin. Future studies may want to consider including a true control group in addition to sham/placebo groups. The use of the weight bearing lunge position for ankle ROM measurements may also present limitations in itself. Since our study involved observing the effects of cupping on the gastrocnemius, the use of the lunge position with the knee bent may

have involved more of the soleus calf muscle, rather than just the gastrocnemius. Future research may want to consider a different weight bearing measurement position in order to prevent the involvement of the soleus muscle.

Finally, the survey data we collected on patient reported outcomes was added a few months into the data collection process, therefore, the response rate was much lower than if the survey was given to participants immediately post-intervention. Additionally, due to the delay in survey administration, participants may not have remembered exactly how the cupping intervention felt. We recommend that survey data related to patient-reported outcomes and blinding be collected earlier or immediately after receiving treatment in order to avoid this bias.

**Conclusion**

This study aimed to investigate the immediate effects of static and dynamic cupping therapies on ankle ROM in comparison to sham cupping. The findings of this study indicate that both static and dynamic cupping, as well as the sham cupping interventions, led to an improvement in ankle ROM immediately after treatment. However, the dynamic cupping group showed a clinically significant increase in ankle ROM above the MCD threshold, while the other groups did not reach this threshold. These findings suggest that dynamic cupping may be more effective than static cupping for improving ankle ROM in individuals with limited ankle dorsiflexion. The sham cupping interventions allowed for blinding of participants and helped assess the possibility of a placebo effect, indicating that the improvements in ankle ROM were not solely due to placebo effects, however it may explain why all groups showed some improvement in ankle ROM.

Despite limitations, this study contributes to the understanding of the effects of cupping therapy on ankle ROM and provides valuable insights for the potential benefits of dynamic cupping. Clinicians and researchers can consider dynamic cupping as a potential intervention to address limited ankle ROM and its associated complications. Further investigation is warranted to explore the long-term effects of cupping therapy, as well as the underlying mechanisms that contribute to its therapeutic effects, with the inclusion of sham groups to eliminate performance bias.

# CHAPTER 3: FUTURE DIRECTIONS

With our data showing that cupping therapy, regardless of real or sham, increases ankle dorsiflexion, this can help clinicians determine if cupping is an appropriate modality to use with patients for mobility issues in the calf. However, this is the only study found examining the impact of static versus dynamic cupping and so further research is needed with active and passive cupping in order to determine the effects of these different cupping techniques on different muscle groups. It is also imperative to gain more research on the effectiveness of the placebo cupping, in order to continue validating that the sham cups are successful in blinding participants. This study is the only one that found a significant increase in ROM in every group, with the static group having the least increase in ROM. Further research can help determine if the results of this study is due to smaller sample size or if basic ROM exercises can increase ankle dorsiflexion as well. Completing studies with ankle pumps as an intervention group against cupping may be a way to determine the effectiveness of this modality as well. Since our sample size was also smaller, more participants in each group can give a better idea on the effects of the two cupping therapies on ankle dorsiflexion, as well as expanding it into other muscles and ROM in the body, such as hamstrings, cervical spine/neck, and lumbar spine. Studies may also take advantage of perceived outcome measure and blinding surveys to determine the patient satisfaction of the treatment, as well as the success rate of the sham cupping techniques.

REFERENCES


1. Hammons D, McCullough M. The Effect of Dry Cupping on Gastrocnemius Muscle Stiffness, Range of Motion and Pain Perception After Delayed Onset Muscle Soreness. *Altern Ther Health Med*. 2022;28(7):80-87
2. Warren AJ, LaCross Z, Volberding JL, O'Brien MS. Acute Outcomes Of Myofascial Decompression (Cupping Therapy) Compared To Self-Myofascial Release On Hamstring Pathology After A Single Treatment. *Intl J Sports Phys Ther*. 2020;15(4):579-592. doi:10.26603/ijspt20200579
3. Klecan K. The Use of Dry Cupping with Active Movement to Increase Functional Mobility and Decrease Pain in a Patient with Cervical Disc Disorder: A Case Report. University of Iowa. Published 2018.
4. Lowe DT. Cupping therapy: An analysis of the effects of suction on skin and the possible influence on human health. *Complementary Therapies in Clinical Practice*. 2017;29:162-168. doi:10.1016/j.ctcp.2017.09.008
5. Xie J. *The Effects Of Static Versus Dynamic Myofascial Decompression On Hamstring Flexibility In A College-Aged Population: A Pilot Study*.Thesis. California State University, Fresno; 2017
6. Wood S, Fryer G, Tan LLF, Cleary C. Dry cupping for musculoskeletal pain and range of motion: A systematic review and meta-analysis. *Journal of Bodywork and Movement Therapies*. 2020;24(4):503-518. doi:10.1016/j.jbmt.2020.06.024
7. Konor MM, Morton S, Eckerson JM, Grindstaff TL. Reliability Of Three Measures Of Ankle Dorsiflexion Range Of Motion. 2012 Jun;7(3):279-87. Published 2012 Jun 7.
8. Krause DA, Cloud BA, Forster LA, Schrank JA, Hollman JH. Measurement of Ankle Dorsiflexion: A Comparison of Active and Passive Techniques in Multiple Positions. *Journal of Sport Rehabilitation*. 2011;20(3):333-344. doi:10.1123/jsr.20.3.333
9. Stephens SL, DeJong Lempke AF, Hertel J, Saliba S. Clinical usage, application procedures, and perceived effectiveness of cupping therapy among healthcare professionals in the United States: A cross-sectional survey. *Complementary Therapies in Clinical Practice*. 2022;48:101610. doi:10.1016/j.ctcp.2022.101610
10. Silva HJ de A, Saragiotto BT, Silva RS, Lins CA de A, de Souza MC. Dry cupping in the treatment of individuals with non-specific chronic low back pain: a protocol for a placebo-controlled, randomised, double-blind study. *BMJ Open*. 2019;9(12):e032416. doi:10.1136/bmjopen-2019-032416
11. Schafer MD, Tom JC, Girouard TJ, Navalta JW, Turner CL, Radzak KN. Cupping Therapy Does Not Influence Healthy Adult's Hamstring Range of Motion Compared to Control or Sham Conditions. *Int J Exerc Sci*. 2020;13(3):216-224. Published 2020 Feb 1.
12. AlKhadhrawi N, Alshami A. Effects of myofascial trigger point dry cupping on pain and function in patients with plantar heel pain: A randomized controlled trial. *Journal of Bodywork and Movement Therapies*. 2019;23(3):532-538. doi:10.1016/j.jbmt.2019.05.016
13. Li L, Wei Y, Xiang S. Influences of PNF Stretching on Physical Fitness in Aerobic Athletes. *Rev Bras Med Esporte.* 2023;29:e2023_0065. doi:10.1590/1517-8692202329012023_0065

14. Baggett BD, Young G. Ankle joint dorsiflexion. Establishment of a normal range. *J Am Podiatr Med Assoc.* 1993;83(5):251-254. doi:10.7547/87507315-83-5-251
15. Erdfelder E, Faul F, Buchner A. GPOWER: A general power analysis program. *Behavior Research Methods, Instruments & Computers*. 1996;28(1):1-11. doi:10.3758/BF03203630
16. Youdas JW, Krause DA, Egan KS, Therneau TM, Laskowski ER. The Effect of Static Stretching of the Calf Muscle-Tendon Unit on Active Ankle Dorsiflexion Range of Motion. *J Orthop Sports Phys Ther*. 2003;33(7):408-417. doi:10.2519/jospt.2003.33.7.408
17. Murray D, Clarkson C. Effects of moving cupping therapy on hip and knee range of movement and knee flexion power: a preliminary investigation. *Journal of Manual & Manipulative Therapy*. 2019;27(5):287-294. doi:10.1080/10669817.2019.1600892
18. Abassi M, Whiteley R. Serial Within-Session Improvements in Ankle Dorsiflexion During Clinical Interventions Including Mobilization-With-Movement and A Novel Manipulation Intervention - A Case Series. *Int J Sports Phys Ther*. 2021 Aug 1;16(4):1158-1168. doi: 10.26603/001c.25544.
19. de Vet HC, Terwee CB, Ostelo RW, Beckerman H, Knol DL, Bouter LM. Minimal changes in health status questionnaires: distinction between minimally detectable change and minimally important change. *Health Qual Life Outcomes.* 2006 Aug 22;4:54. doi:10.1186/1477-7525-4-54.
20. Almeida Silva HJ, Avila MA, Castro KMS, et al. Exploring patient experiences of participating in a real and sham dry cupping intervention for nonspecific low back pain: A qualitative study. Özden F, ed. *PLoS ONE*. 2022;17(5):e0268656. doi:10.1371/journal.pone.0268656
21. Smith JD, Morrison A, Villarreal M. Effects of Brief Dry Cupping on Muscle Soreness in the Gastrocnemius Muscle and Flexibility of the Ankle. *Asian J Kinesiol*. 2021;23(4):3-11. doi:10.15758/ajk.2021.23.4.3
22. Barnes P, Rivera M. The Effect of Active Release Technique® on Clinician and Patient-Reported Outcomes: A Systematic Review. *Journal of Sport Rehabilitation.* Published online 2021:1-6. doi:10.1123/jsr.2021-0106
23. Gaur VV, Kapoor AA, Phansopkar PA. Short Term Effects of Muscle Energy Technique vs. Active Release Technique in Improving Hamstring Flexibility and Pain in Patients with Acute Anterior Cruciate Ligament (ACL) Tear - A Randomized Control Trial. *jemds.* 2021;10(3):137-142. doi:10.14260/jemds/2021/29
24. Kamper SJ, Ostelo RW, Knol DL, Maher CG, de Vet HC, Hancock MJ. Global Perceived Effect scales provided reliable assessments of health transition in people with musculoskeletal disorders, but ratings are strongly influenced by current status. *J Clin Epidemiol.* 2010;63(7):760-766.e1. doi:10.1016/j.jclinepi.2009.09.009

# APPENDIX A: STUDY DOCUMENTS

NORTHERN MICHIGAN UNIVERSITY

**Graduate Studies and Research**
Marquette, MI 49855-5301
906-227-2300
www.nmu.edu/graduatestudies/

**MEMORANDUM**

**TO:** Megan Nelson
School of Health and Human Performance

Alex Schaub

**DATE:** February 17, 2023

**FROM:** Lisa Schade Eckert
Dean of Graduate Studies and Research

**RE:** Modification to HS22-1287
Original IRB Approval Date: 3/24/2022
Modification Approval Date: 2/17/2023
"Effects of Static Versus Dynamic Cupping on Ankle Dorsiflexion"

---

Your modification for the project "Effects of Static Versus Dynamic Cupping on Ankle Dorsiflexion" has been approved by the Northern Michigan University Institutional Review Board. Please include your proposal number (HS22-1287) on all research materials and on any correspondence regarding this project.

Any additional personnel changes or revisions to your approved research plan must be approved by the IRB prior to implementation. Unless specified otherwise, all previous requirements included in your original approval notice remain in effect.

Until further guidance, per CDC guidelines, the PI is responsible for obtaining signatures on the COVID-19 Researcher Agreement and Release and COVID-19 Research Participant Agreement and Release forms.
If you have any questions, please contact the IRB at hsrr@nmu.edu.