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Comparison of Range of Motion After Aquatic vs Land Exercises on Young Adult Men

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Abstract

Range of motion is the degree to which joints in the body can extend or flex. This is essential to performing actions such as bending over, reaching, and other daily activities. This study investigated the effects of aquatic versus land exercises on range of motion. It was hypothesized that the participant completing the aquatic exercises would have a greater increase of range of motion. Three male participants were recruited to participate in the study. Each participant was placed into a different group- control, aquatic, or land. The control participant measured their range of motion at the beginning and end of the experiment without modifying anything in their daily life. The aquatic and land-based participants measured their range of motion at the beginning and end of the experiment, while doing exercises in either land or water, whichever group they were in, and stretches over a course of two weeks. The experiment was conducted over a two-week span with participants completing 10 total days of exercises, 5 each week. No face-to-face research was completed due to COVID-19, eliminating personal contact. The data was compiled and examined proving that although the aquatic group increased range of motion, there was no significant difference. This did not support the hypothesis previously stated. Therefore, it cannot be assumed that aquatic exercises will increase range of motion greater than land exercises to a significant amount. Possible modifications to this experiment that could have changed the outcome are increasing sample size and lengthening the duration of the study.

Keywords: range of motion, flexibility, exercises, aquatic, land

Part I: Introduction

What if there was a faster way to heal from an injury? What if the technology for this to be possible already existed? Would people be willing to try a new technique out of their comfort zone? In today's society, recovering quickly from a physical injury can make a difference in someone's life such as between being able to go back to work faster, live a normal life again, or even return back to a sport. There are several research studies that have suggested that aquatic therapy may lead to quicker recovery time (Pérez de la Cruz, 2020, Catalin, Nicolae, & Margit 2019, Ahmadi, Yalfani, & Gandomi, 2019, Villalta & Peiris, 2013, Kargarfard, M., Dehghadani, M., & Ghias, R., 2013, Alejo, T., Shilhanek, C., McGrath, M., & Heick, J.D., 2018). In the next section this will be discussed further with data. Essentially, those who have an injury can utilize aquatic therapy to increase their range of motion quicker thus leading to a faster recovery time. Aquatic exercise is ideal for people who suffer from joint issues or problems that stemmed from either an injury or being overweight. Aquatic exercises are a way for people to increase their strength, cardiovascular fitness, and stamina quickly without worrying about high impact on joints and/or a loss of balance while performing the movements. While land therapy still helps and leads individuals to a full recovery, it is imperative that new ways of therapy be researched to determine what is best for every individual. In order to have a quick recovery time, decreasing the amount of time an individual spends on regaining their range of motion is the perfect starting point. Range of motion is the amount of flexibility an individual has in a certain joint in their body (Stoppler, 2021). Therefore, this experiment dives right in to test if range of motion will increase greater with a healthy man in his 20s performing aquatic exercises versus a healthy man in his 20s performing land exercises over a period of time. Although these individuals are not injured, it is important to note that those who are healthy can still increase their range of motion.

Having good range of motion can lead to living pain-free and prevents injury in the future. This experiment is helpful to advance knowledge on this topic and since there is no injury that the participants are recovering from, it eliminates issues with range of motion due to an injury. This makes it much easier to focus on the range of motion specifically. For the purpose of this study, range of motion in the hip, knee, and shoulder was observed. Commonly this range is measured in degrees with a device called a goniometer (Physiopedia contributors, 2021), but in this study an application called Coach's Eye was used to measure the range of motion in a video due to face-to-face research being suspended because of COVID-19. This paper examined previous research that has been done on aquatic therapy and similar studies. Catalin, Nicolae, & Margit (2019) discussed the difference between aquatic and land-based therapy on males aged 16-18 recently receiving knee surgery and concluded that the aquatic group had better range of motion over time. In light of this research, the hypothesis for this experiment was the participant completing the aquatic exercises will show a greater range of motion increase over a ten-day period of time rather than the participant completing the land exercises.

Part II: Literature Review

Range of motion is an essential part to any rehab when recovering from an injury. In order to return back to normal functioning and have the ability to perform daily tasks, complete movement of any joint is necessary. Regaining or growing range of motion is done through stretches and exercises. After weeks of doing certain stretches for a particular joint or body part, range of motion may be able to be completely recovered. According to Pérez de la Cruz (2020), Catalin, Nicolae, & Margit (2019) and others mentioned later, current research suggests that aquatic therapy may be able to increase range of motion more efficiently than doing the same

exercise on land. Thus, this study was done to test whether or not range of motion increases greater on land vs water on males ranging from 20-29 years of age. We hypothesize that over 2 weeks, range of motion will increase greater with the participant that is completing the aquatic exercises versus the participant completing the land exercises.

Considerable amount of research has been conducted on aquatic therapy and the benefits it possesses. Two articles that will be discussed in detail further down also compared the effects of land versus aquatic exercises but with stroke patients (Pérez de la Cruz, 2020) and knee replacement patients (Catalin et. al., 2019). Additionally, research has been conducted on patients suffering from upper crossed syndrome ("tightness of the upper trapezius and levator scapula on the dorsal side crosses with tightness of the pectoralis major and minor" Physiopedia contributors, 2020) and the effects of aquatic therapy on their pain. Therapy in water has also been used in two special populations, one with those who have hemophilia (Kargarfard et. al., 2013) and another with those who had orthopedic surgeries (Villalta & Peiris, 2013). Finally, there has been further research done that combines manual therapy and aquatic therapy (Alejo, T., Shilhanek, C., McGrath, M., & Heick, J.D., 2018). There is no lack of research detailing the perks of aquatic therapy and how it can increase range of motion while decreasing pain. Most research that has been conducted was completed with participants suffering from a preexisting condition or injury. While this may be the most likely environment in which aquatic therapy is performed, there is a lack of research examining the effects on healthy individuals. Range of motion is essential for everyone, not just those who are injured or suffer from a disease. This is essential since motion of joints are what allow people to move. Thus, it is important to maintain or increase range of motion to prevent injury and perform everyday activities. Therefore, it is essential to dive deeper and determine the effects that water exercises have on range of motion

when compared to land exercises. By understanding if healthy individuals can also obtain the same benefits that individuals who are injured can, it has the ability to take aquatic exercise to a new understanding. Individuals hoping to increase their range of motion can then complete aquatic exercises to attain their goals faster than they would on land.

Pérez de la Cruz (2020) conducted a study comparing different therapy environments for stroke patients. All participants were at least 35 years old, suffered from a stroke at least one year prior to therapy, able to move at least 10 meters with or without assistance, could tolerate interventions and assessments, and could follow verbal commands. From this, three groups were created. First, a control group that only received dry-land therapy which involved simple exercises such as walking and trunk mobility. Second, an experimental group that received a type of aquatic therapy called Ai Chi. “Ai-Chi is a technique that is applied in deep water, with the water at shoulder height and the knees slightly bent; therefore, water resistance is available for all limbs and the torso while practicing Ai-Chi” (Pérez-de la Cruz, 2020). And third, another experimental group that received both aquatic and dry-land therapy. Each group was assessed with four different tests prior to the experiment beginning and after 12-weeks of their designated therapy. They were additionally assessed 4-weeks following the experiment to determine long term effects. The results concluded that the experimental group in which there was a combination of aquatic and land-based therapy exemplified significant improvements in balance, functionality, and a quality of life (Pérez-de la Cruz, 2020). This research is important in that it brings into a new thought process that perhaps it is not one environment that is best for treatment, it may be that a balance of the two are best. This is due to the fact that the results pointed to seeing the best results with both land and aquatic therapy participants. Additional

research examining the use of aquatic therapy for stroke patients is warranted to establish efficacy in this population.

Catalin, Nicolae, & Margit (2019) investigated the difference in aquatic therapy and land-based therapy on males between 16-18 years old recently receiving knee surgery. This is similar to the previous article in that it compares the differences between the two environments for therapy differences being a younger population and no control group. In this study, there were two groups, land-based therapy and aquatic-based therapy. Each participant completed 10 days of therapy, followed with 5 months of therapy 3x a week. During this time, several factors were monitored such as articular mobility, pain intensity, physical fitness, and quality of life. The results determined that within 10 days of therapy as well as 5 months afterwards, the aquatic-based therapy recorded higher range of mobility than the land-based group but they scored similar on pain intensity and fitness scale (Catalin et al., 2019). Although study continued research for 5-months, there were also significant findings within 10 days at the beginning. This is important to note due to the fact that the current experiment is only 10 days. This reinforces and supports the hypothesis that range of motion will increase more efficiently when exercises are completed in water.

A study by Ahmadi, Yalfani, & Gandomi (2019), is unique in that it dealt with everyday people that suffer from upper crossed syndrome. This is a common muscle imbalance between the upper trapezius, levator scapula, pectoralis major, and pectoralis minor but can be fixed over time (Young & Morrison, 2018). There were 30 students all suffering from upper crossed syndrome placed into two groups, aquatic exercises and a control group. The aquatic group completed water exercises while the control group did not participate in any exercises. Pre and post range of motion of the neck and shoulder were measured along with neck flexor endurance

and neck pain. With these results, it was found that there were significant differences between each group that was measured (Ahmadi et al., 2019). This study demonstrates that the aquatic therapy had an overall positive effect on reducing and improving the participants upper crossed syndrome. It should be noted that these individuals were students, thus being in a younger population similar to the current experimental group. Unfortunately, this experiment did not include a land-based group which would have allowed for additional comparison. On the other hand, it still reinforces the idea that aquatic exercises are able to reduce pain and increase range of motion on individuals with upper cross syndrome. Results from this study suggest that in healthy, younger populations aquatic exercise may be a way to increase range of motion. There must be further research conducted to determine if this can be also applied to lower body flexibility.

Villalta & Peiris (2013) examined the effects of early aquatic therapy on patients' post-orthopedic surgeries. This meta-analysis condenses 8 other trials in order to use data to compare existing research of the 287 participants. Once all of the trials had their data extracted and compiled together, the information was analyzed and used to make conclusions. It was found that aquatic therapy does improve function and does not increase risk for wounds when compared to land-based data. This means that both aquatic and land-based therapy had the same effectiveness for early therapy (Villalta & Peiris, 2013). Although this does not support the hypothesis that aquatic exercises will be more efficient in increasing range of motion, it still has some important results. It is important to note that these trails were performed less than 3 months after surgery, and there may have been different changes after the trials. Additionally, it is also notable that aquatic therapy did result in improvements in the individuals, and it did not cause any harm.

Therefore, it appears that aquatic therapy and land-therapy may have the same results, they are both safe and healthy for anyone needing rehab after surgery.

Kargarfard, M., Dehghadani, M., & Ghias, R. (2013) studied individuals with hemophilia, a congenital genetic disorder in which individuals lack the protein in plasma that clots blood (Mayo Clinic contributors, 2020), to determine the effects water exercises had on muscle strength and range of motion. The twenty males suffering from moderate hemophilia were separated into two groups. The first group was the experimental group in which they were given aquatic exercise to complete and the second group was a control group in which they were not prescribed any exercises. Throughout the 8-week experiment, the participants were measured at their ankle, knee, and elbow joint to determine any changes. The experimental group was found to have significant improvements in both muscle strength in the knee joint as well as range of motion. The right leg strength in the control group did have significant improvements, but that was the only improvement out of all the tests (Kargarfard et al., 2013). This study revealed that the aquatic exercises are a safe and helpful method to help those who suffer from hemophilia. Sometimes individuals with hemophilia are unable to participate in certain exercises due to the risk that they may hurt themselves then cannot stop bleeding, but this was not a concern during the water exercises. This was interesting because hemophilia patients are sometimes in need of surgical options to help treat these individuals demonstrating that improvements in muscle power and range of motion may be expected without negative impact on the hemophilia.

Alejo, T., Shilhanek, C., McGrath, M., & Heick, J.D. (2018) investigated the effects of manual therapy done in water both male and female recreational athletes between the ages of 18-60 with injuries in the ankle, knee, or hip. This study is similar to the current one in that the mean ages are both with a younger population in their 20s and that it investigates participants

that are already active or were prior to injury. AquaStretch ™ (Eversaul et. al., 2001) is a type of technique that involves manual therapy in an aquatic environment. "This intervention (Aquastretch™) has been reproduced in clinical settings and has shown improvement in range of motion (ROM) after a single treatment session in non-injured individuals. Aquastretch™ has anecdotal clinical evidence but limited research evidence to show its usefulness to restore ROM and function" (Alejo, et. al., 2018). The purpose of AquaStretch ™ is to increase range of motion and function for individuals who utilize it (Alejo, et. al., 2018). Twenty-six individuals with lower extremity injuries participated in a single 30-minute intervention session of AquaStretch ™. Pre and post self-reported perceptions of lower extremity function and foot and ankle ability as well as ROM and functional tests were performed. Results revealed significant improvements in patient-rated functional abilities. ROM and functional test revealed no significant changes (Alejo et. al., 2018). This may have been due to the fact that it was only one session, and with any therapy there is not a lot of change between just one session. It is noteworthy that participants perceived improvements functionality. This is a very interesting article in that manual therapy in water is not a very common technique. Further research using AquaStretch ™ is warranted to examine the efficacy as a therapy modality. This research is much different than the other articles in that it experiments with a new type of therapy, but it is important to notice that there is an incredibly wide variety of therapies open to use when treating patients. It opens a door for potentially new studies to be done.

Overall, these articles give a wide view of current research that has been done with aquatic therapy, whether it was comparing it to land-based activity or solely looking at water activities. Each study has its own unique change that provides for a different lens of how aquatic therapy can be utilized with patients. From the current body of research, it appears that aquatic

therapy is useful in increasing range of motion and functionality. Aquatic therapy lessens the effect of gravity which reduces the weight-bearing impact. It also decreases the risk of falling, reduces swelling in the joints, and much more (Inverarity & Campedelli, 2020). All of these benefits in water therapy combine to allow the individual to increase their range of motion. The current study examines healthy individuals, whereas the participants in these studies are compromised in some way. The research discussed in this review includes a greater number of participants who have some type of injury or pre-existing condition. The limited number of participants in our study is due to restrictions on face-to-face research because of COVID-19. A commonality between some of the studies and our study is that some of them are for only a short duration whereas our study is for 2 weeks. Some of the studies were still able to see significant differences in a short period of time. Understanding other common research that is published allows for new research to be done to investigate different aspects to each study. It allows for a broader knowledge on a topic so that it may be applied to everyday life. Aquatic therapy is already widely used in many clinics for physical therapy but with more research it's use may be relevant in healthy individuals to maintain and increase range of motion. Land-based stretches and exercises still provide a great way to increase range of motion, but aquatic stretches may be a more efficient way to obtain goals due to the benefits that water has to offer. Aquatic exercises may not be pleasurable for everyone since some may have a fear of water or dislike wearing a bathing suit. While this is important to acknowledge, having more therapy options, such as water, when treating an individual makes it easier to recruit people of different backgrounds and abilities. All of the current research helps to strengthen and further suggest that aquatic therapy is extremely beneficial in improving range of motion and in most cases is more favorable than land-based exercises. These articles still beg the question of whether or not these new

environments would still apply to those who are healthy. Thus, creating an experiment that continues with aquatic exercises but then recruits male individuals ages 20-29 with no health issues is essential in comparing it to previous research. The data collected will allow for the information to be more versatile as opposed to only being relevant to those who are injured.

Part III: Methods

This section will describe the research methodology, geographical areas where the study was conducted, the study design, and the population and sample. It will also outline what was used to collect the data and how the data was analyzed. The methods used to ensure the validity and accuracy of the data are also explained in this section. In addition, this methods section will include the research protocol, what measurements and calculations were conducted, and what statistical tests were performed to analyze the data.

This study was approved by The University of Akron Institutional Review Board (Appendix A). This study did not include a large number of subjects and focused on a small number of individuals. This was due to the COVID-19 restrictions placed on the University of Akron regarding in-person research. The researchers chose to focus on a case-study type of research in order to eliminate face-to-face interactions during the study. The recruitment of participants took place by reaching out to interested young adult males. There were 3 participants recruited for the experiment. After agreeing to participate they completed an Informed Consent (Appendix B) and completed a physical activity readiness questionnaire (PAR-Q+) (Appendix C) (Warburton, et. al., 2021). A PAR-Q questionnaire is a physical activity readiness questionnaire for everyone. This is used to determine any healthy or lifestyle issues prior to participating in exercise. Passing the PAR-Q questionnaire included answering “no” to all of the

first 7 questions or if answered yes to one or more, the participants needed to answer follow up questions to determine if it is safe to exercise. The PAR-Q indicated whether the individual is safe to exercise depending on their answers to the questions. Participants were between the ages of 20-29 with the ability to perform the exercises given to them in the "Exercises for Participants Document" prior to the beginning of the study (Appendix D). The six different exercises included shoulder, hip, and knee movements to perform during the two-week period. The participants were also given five range of motion stretches on a document with photos (Appendix E) to perform along with the exercises. Exercise logs (Appendix F) were given to the participants. Video cameras and a phone application called Coach's Eye (TechSmith Corporation, Okemos, MI) were utilized to measure range of motion. This application allowed the videos and pictures sent by the subjects to be analyzed regarding the range of motion of the shoulders, hips, and knees. The Coach's Eye (TechSmith Corporation, Okemos, MI) application had the videos uploaded then stopped at certain points when the participant has reached their full range of motion. The application was then used at the stopped parts to draw directly onto the videos using lines and arrows to measure in degrees the range of motion in the specific joints for data collection. This provided the data from the participants' videos. This was similar to the measurements from a goniometer with the exception of being in person. The use of technology eliminated in-person contact while also allowing the researchers the ability to keep a close eye on the progress of the subjects. The researchers practiced using the application before beginning the study to make sure it was being used correctly for data collection. The application allowed the researchers to place the video into a file that can add digital goniometers and values to the different body parts involved. A goniometer is a simple tool that has numbers and measurements on it to allow the person using it to measure how far a joint can stretch. Each participant was

randomly placed in a different grouping category. One group was a control group (CG), one group was the aquatic group (AG), and one group was the land-based group (LG). The control group was not prescribed any exercises but the aquatic and land-based groups were given exercises on a document (Appendix D). These exercises included jumping jacks, high knees, glute kicks, gate openers, cross body arm swings, and arm circles. These subjects were worked with virtually one-on-one and were monitored loosely in order to gain the numerical data needed for calculations. Prior to the experiment, the individuals were asked to participate through text message and given brief information to determine if they were interested. Once recruited, the individuals were emailed all forms and told to complete them and return them back to us. These individuals were able to contact the researchers through email or text message on an as-needed basis. Every day of the experiment the individuals updated their exercise logs and sent videos through email if needed. After the two weeks had passed, the researchers checked-in with the participants to confirm the experiment went smoothly and answered any necessary questions.

This study used a quantitative approach to collect data. The participants were given a document including photos of which stretches to perform that were recorded to measure range of motion (Appendix E). Once the participants reviewed these stretches and learned how to do them, initial range of motion testing was measured at the three joints of the body through doing the stretches. These joints included the shoulders, hips, and knees. The participants took videos or photos of themselves doing the stretches then emailed them to the researchers for data. The stretches for the shoulder joint included the individual to flex one shoulder and elbow so that the fingertips touch the back and hyperextend the other shoulder while flexing the elbow with fingertips touching the back. The stretches for the knee joint were knee flexion, in that the participants were in a prone position and flex their knee towards their glute. The stretches for the

hip joint were hip abduction which required the participant to lay on their side and moved their leg away from their midline as far as they can, and hip flexion which required the participant to be supine and flex hip and knee to their chest. All stretches were performed bilaterally. This means that each stretch was performed on both sides of the body (left and right).

Hip Flexion w/ flexed knee

- Participants were instructed to lie supine flexing knee and hip unassisted (no hands) to their chests.

Hip Abduction

- Participants were instructed to lie on their sides and abduct the top leg as far as they can unassisted (no hands).

Knee Flexion

- Participants were instructed to lie prone while unilaterally flexing the knee to touch their heel to their hip unassisted (no hands).

Hand Behind Back (Overhead)

- Participants were instructed to stand with their backs straight (pretend there was a pencil they were trying to hold between their shoulder blades). They then unilaterally flexed the shoulder and elbow to try to touch as far down their backs as they could.

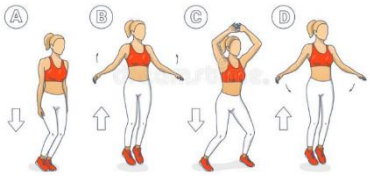
Hand Behind Back (Under)

- Participants were instructed to stand with their backs straight (pretend there was a pencil they were trying to hold between their shoulder blades). They then hyperextended the shoulder and flexed the elbow to try to touch as far up their backs as they could.

After initial testing, the intervention lasted 2 weeks, with the water and land groups completing the same exercises but in different environments. The water participant completed the exercises in The University of Akron Recreation Center Leisure Pool on their own time. The land participant completed the exercise at a place of their choice, such as their home. No specific exercises were assigned to the control participant, they were instructed to continue their normal routine. This was to have an unbiased subject with which the researchers could compare the land and water subjects' data. The water and land participants completed the exercises 5x a week for 2 weeks. The exercises that the participants completed were jumping jacks, high knees, glute kicks, gate openers, cross body arm swings, and arm circles.

Jumping Jacks

Land

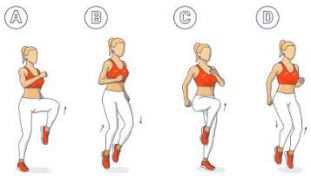


Water

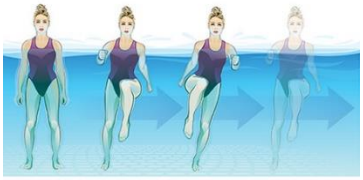
- These are the illustrations of the jumping jacks exercise that was given to the land and water participants.

High Knees

Land



Water



- These are the illustrations of the high knees exercise that was given to the land and water participants. This is where the participants rapidly flexed the hip (alternating between left and right) up to a ninety-degree angle.

Glute Kick

Land

Water

- These are the descriptions of the glute kick exercise that was given to the land and water participants. Each knee was flexed so that the heel of the foot was brought up to the glutes in a quick, alternating pattern.

Gate Openers

Land

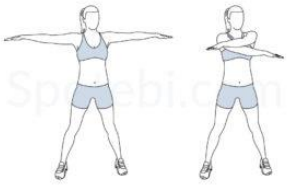
Water

No picture. Do the same thing as the land exercise but in water.

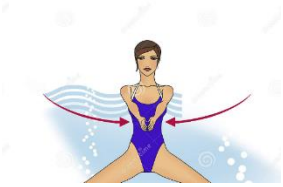
- This is the illustration of the gate opener exercise that was given to the land and water participants. While standing one place, participants alternately circumducted the hip and then returned to starting position.

Cross Body Arm Swings

Land



Water



- These are the illustrations of the cross-body arm swing exercise that was given to the land and water participants. While standing in one spot, the horizontally abducted and adducted the shoulders, crossing them in the process.

Arm Circles

Land

Water

(no weight)

- These are the descriptions of the arm circle exercise that was given to the land and water participants. While standing in one spot with knees shoulder width apart, the participants abducted the shoulders. They then circumducted the shoulders in small, circular motions.

After every session of exercises, they recorded videos of themselves doing the range of motion stretches. The control participant recorded themselves doing only the range of motion , no exercises, 5x a week and sent it to the researchers. Only the stretches were recorded and sent to the researchers, not the exercises. The land and water subjects were given an exercise log to record their completion of exercise and leave any notes. Once the videos were obtained, the researchers then utilized the Coach's Eye (TechSmith Corporation, Okemos, MI) application to measure the joints. Each measurement was recorded down onto a chart. After compiling all of this data over a 2-week period there were comparisons done with the data.

The statistical test used to analyze the subjects' data was a two-tailed t-test. This type of test was used to see whether there was a significant difference between the land and water subjects. A two-tailed t-test analyzes two groups and looks at whether a sample is less than or greater than a specific range of values. Once this test was performed, a p-value will be obtained. If the data is statistically significant, then the p-value will be less than 0.05. In contrast, if the data is not statistically significant, then the p-value will be greater than 0.05. The control participant's data was not used during the calculations section of the study. The control subject's data was used as a reference to be able to see if there was any real difference between exercising in water in comparison to exercising on land. The control participant was also not required to fill out the exercise log due to him not having to exercise for the purpose of this study.

The subjects involved included three males between the ages of 20-29 years old. Males were chosen due to them being statistically less flexible than females. According to an article by Lexie Williamson (2020), a British Wheel of Yoga and Yoga Sports Science instructor who specializes in working with endurance athletes, there is a greater proportion of connective tissue within muscle in males versus females. A man's body contains more testosterone than women.

This oftentimes makes a male's muscles bulkier and less malleable than a female's leaner muscles. Some possible limitations to the research would be user error as well as technological error while the videos were filmed and the researchers using the Coach's Eye (TechSmith Corporation, Okemos, MI) application to analyze those videos. Another limitation to this research was its limited number of participants. User error can stem from the researchers having not used the Coach's Eye (TechSmith Corporation, Okemos, MI) application correctly in addition to the participants not recording their videos correctly. This may have caused an angle to look distorted which would then cause an imbalance in recorded values. The limited number of participants used could cause an issue in variability. With a larger number of subjects, the study could have included a more diverse sample size with numbers and results that could have been more significantly different from one another. The case-study approach that was taken to this research does not allow it to be comparable to larger studies of the same nature due to the limited pool of subjects. A larger study could provide more variability regarding range of motion recordings.

The blank documents given to the participants can be found in the appendices (B-F).

Part IV: Results

In order to display the results, there are tables and calculations completed. Each measurement is separated by joint- shoulder, hip, and knee. The beginning values were recorded along with the final values. Pictures of the participants stretching are included to represent the change in range of motion over ten days. Finally, there are calculations done to determine significant change. This is done through performing a two-tailed t-test with the collected data and then calculating the p-value.

Table 1

*Pre-intervention shoulder measurement***s**

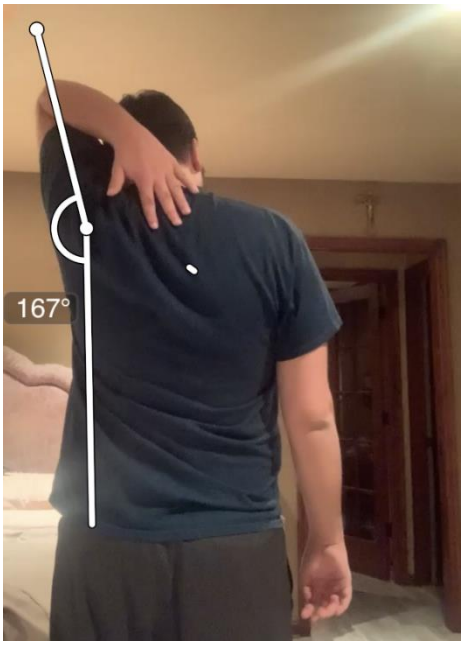
Date	Subject	Range of Motion Stretch	Range of Motion Measurement
2/21/2021	Land	Hand behind head	L: 167º R: 170º
		Hand on low back	L: 159º R: 142º
2/21/2021	Water	Hand behind head	L: 160º R: 161º
		Hand on low back	L: 161º R: 152º
2/21/2021	Control	Hand behind head	L: 169º R: 190º
		Hand on low back	L: 163º R: 149º

*This is a chart depicting the measurements in degrees of the left and right shoulder of each subject (land, water, and control). There were two range of motion stretches performed: hand behind the head and the hand on the lower back. These measurements were taken from the videos provided by the three participants at the beginning of the two-week study period.

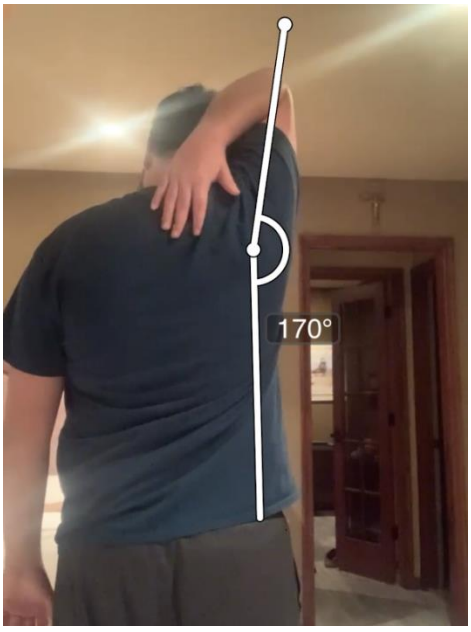
Participant Photos

Land Participant

Left Hand Behind Head

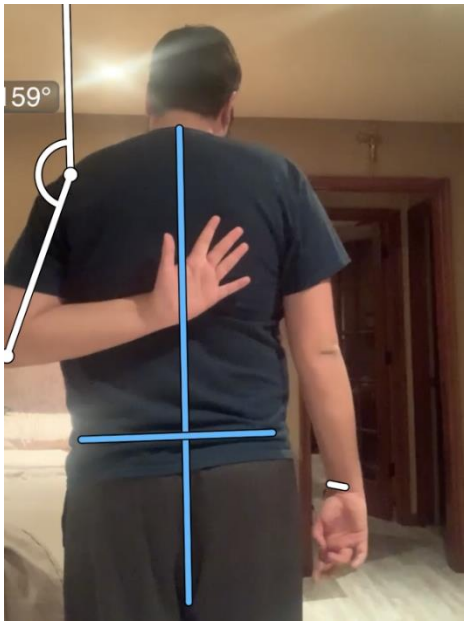


Right Hand Behind Head

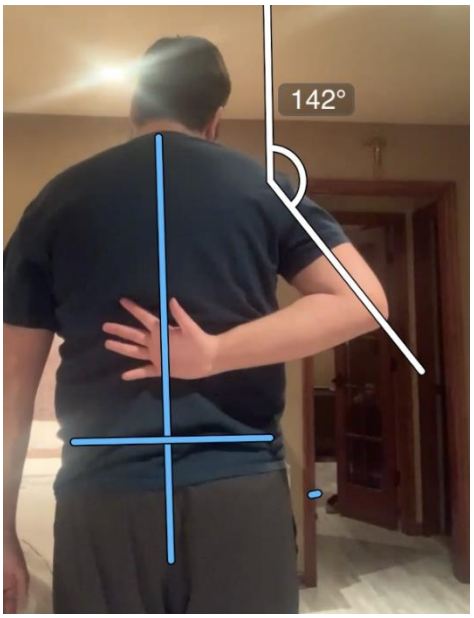


*Snapshots taken from the video provided by the land participant while performing the "hand behind head" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Left Hand on Low Back



Right Hand on Low Back

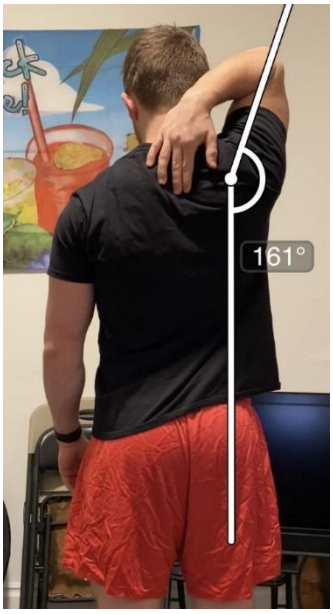


*Snapshots taken from the video provided by the land participant while performing the "hand on lower back" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. The blue lines show the correct body alignment of the subject. This is at the beginning of the two-week period.

Water Participant

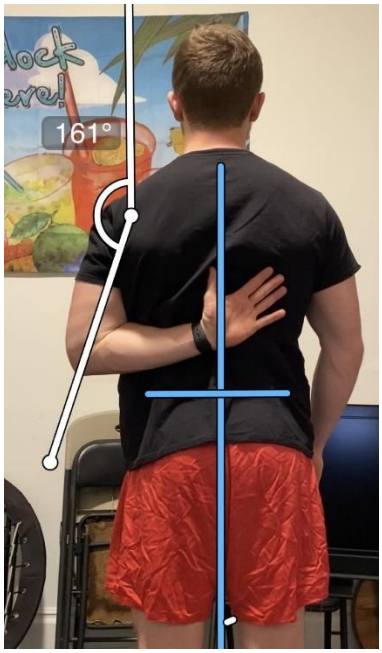
Left Hand Behind Head

Right Hand Behind Head



*Snapshots taken from the video provided by the water participant while performing the "hand behind head" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Left Hand on Low Back



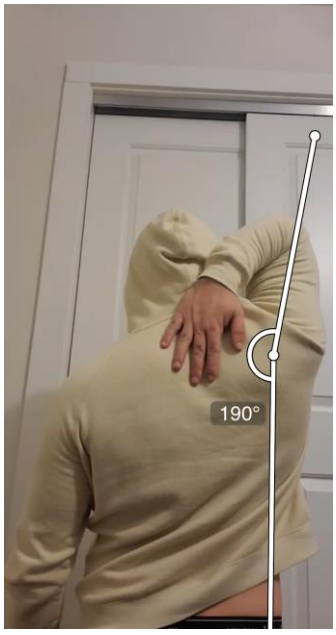
Right Hand on Low Back

*Snapshots taken from the video provided by the water participant while performing the "hand on lower back" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. The blue lines show the correct body alignment of the subject. This is at the beginning of the two-week period.

Control Participant

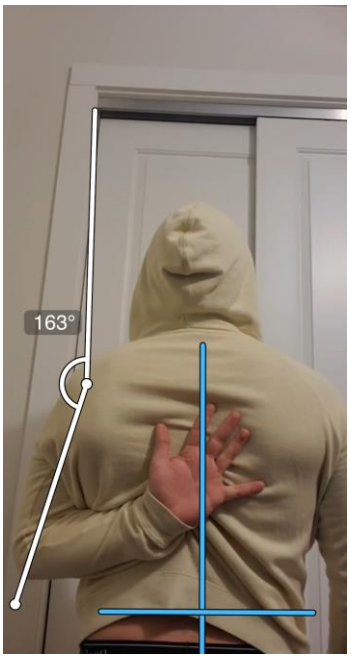
Left Hand Behind Head

Right Hand Behind Head

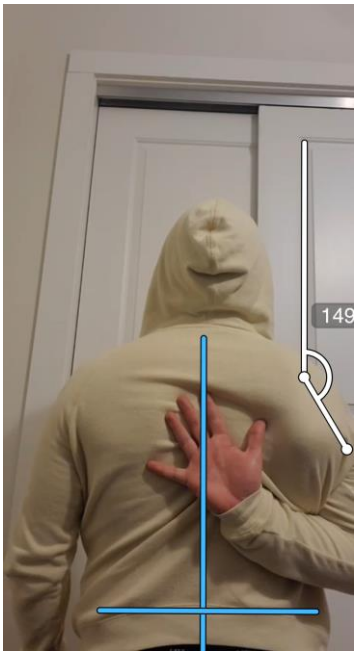


*Snapshots taken from the video provided by the control participant while performing the "hand behind head" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Left Hand on Low Back



Right Hand on Low Back



*Snapshots taken from the video provided by the control participant while performing the "hand on lower back" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. The blue lines show the correct body alignment of the subject. This is at the beginning of the two-week period.

Table 2

Post-intervention shoulder measurements

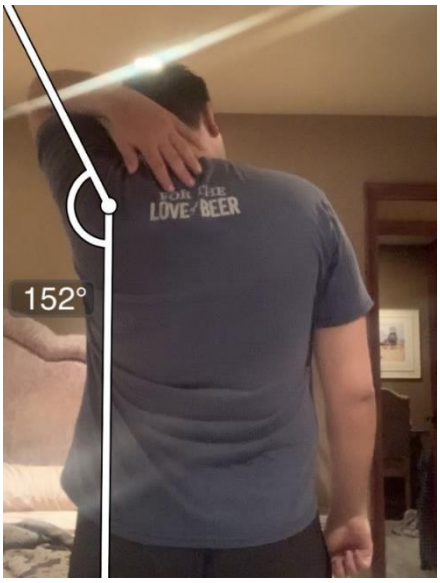
Date	Subject	Range of Motion Stretch	Range of Motion Measurement
3/4/2021	Land	Hand behind head	L: 152º R: 156º
		Hand on low back	L: 135º R: 140º
3/4/2021	Water	Hand behind head	L: 171º R: 165º
		Hand on low back	L: 158º R: 147º
3/4/2021	Control	Hand behind head	L: 175º R: 173º
		Hand on low back	L: 162º R: 158º

*This is a chart depicting the measurements in degrees of the left and right shoulder of each subject (land, water, and control). There were two range of motion stretches performed: hand behind the head and the hand on the lower back. These measurements were taken from the videos provided by the three participants at the end of the two-week study period.

Participant Photos

Land Participant

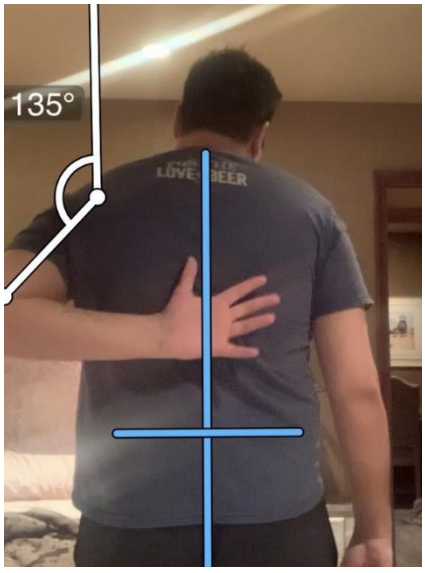
Left Hand Behind Head



Right Hand Behind Head

*Snapshots taken from the video provided by the land participant while performing the "hand behind head" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Left Hand on Low Back

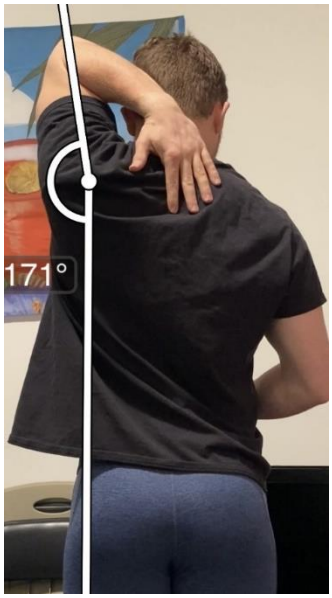


Right Hand on Low Back

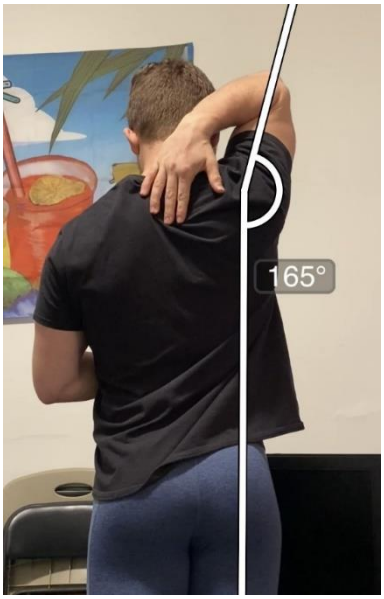
*Snapshots taken from the video provided by the land participant while performing the "hand on lower back" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. The blue lines show the correct body alignment of the subject. This is at the end of the two-week period.

Water Participant

Left Hand Behind Head

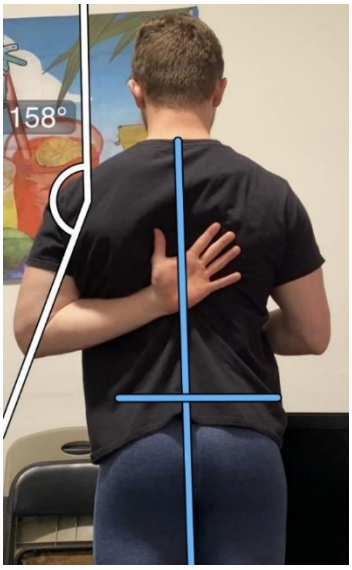


Right Hand Behind Head

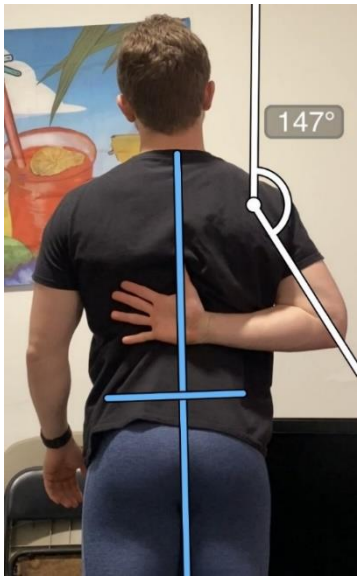


*Snapshots taken from the video provided by the water participant while performing the "hand behind head" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Left Hand on Low Back



Right Hand on Low Back



*Snapshots taken from the video provided by the water participant while performing the "hand on lower back" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. The blue lines show the correct body alignment of the subject. This is at the end of the two-week period.

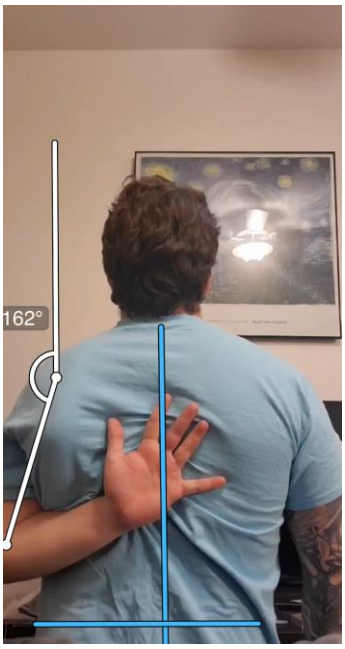
Control Participant

Left Hand Behind Head

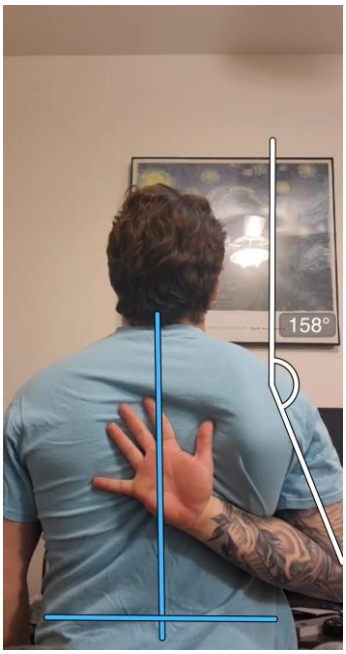
Right Hand Behind Head

*Snapshots taken from the video provided by the control participant while performing the "hand behind head" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Left Hand on Low Back



Right Hand on Low Back



*Snapshots taken from the video provided by the control participant while performing the "hand on lower back" stretch to show the range of motion (ROM) for the left and right shoulder. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. The blue lines show the correct body alignment of the subject. This is at the end of the two-week period.

Table 3

Pre intervention hip measurements

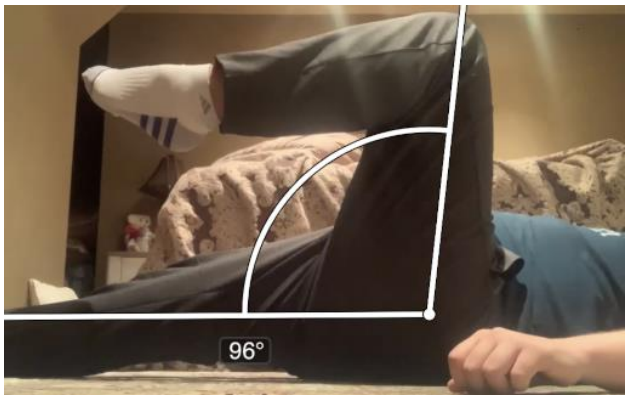
Date	Subject	Range of Motion Stretch	Range of Motion Measurement
2/21/2021	Land	Pull knee to chest	L: 96º R: 97º
		Hip abduction	L: 48º R: 49º
2/21/2021	Water	Pull knee to chest	L: 106º R: 110º
		Hip abduction	L: 58º R: 60º
2/21/2021	Control	Pull knee to chest	L: 102º R: 100º
		Hip abduction	L: 31º R: 36º

*This is a chart depicting the measurements in degrees of the left and right hip of each subject (land, water, and control). There were two range of motion stretches performed: pulling the knee to the chest and hip abduction. These measurements were taken from the videos provided by the three participants at the beginning of the two-week study period.

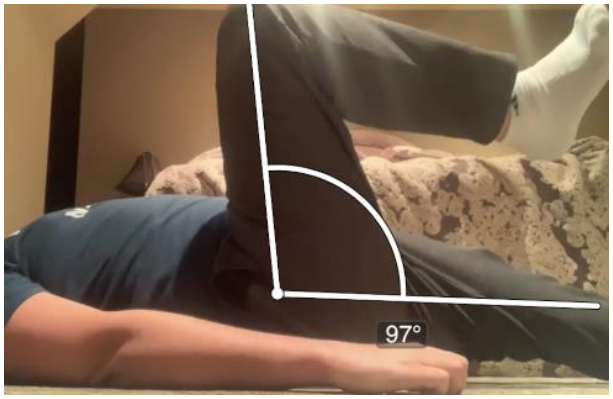
Participant Photos

Land Participant:

Left Knee to Chest



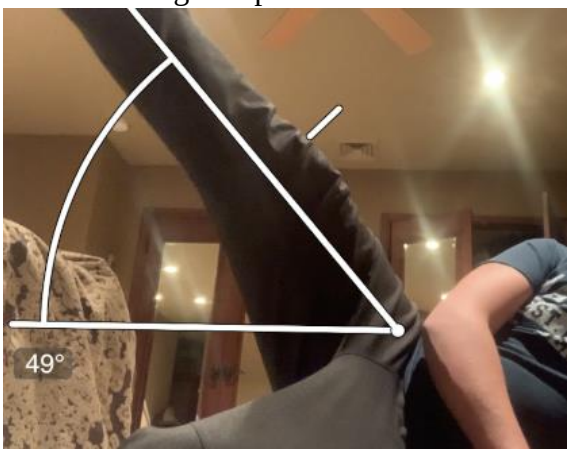
Right Knee to Chest



*Snapshots taken from the video provided by the land participant while performing the "pull knee to chest" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Left Hip Abduction

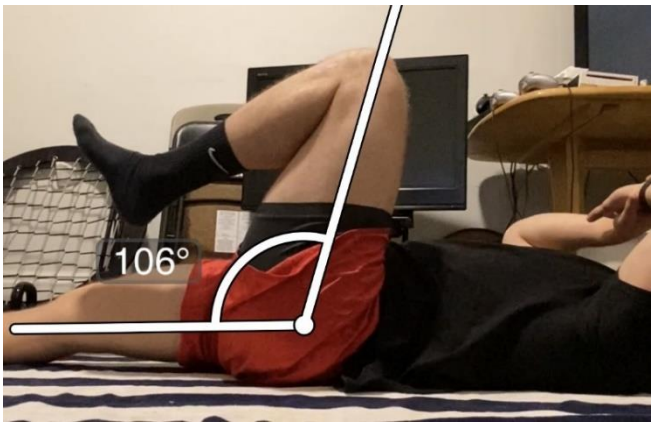
Right Hip Abduction



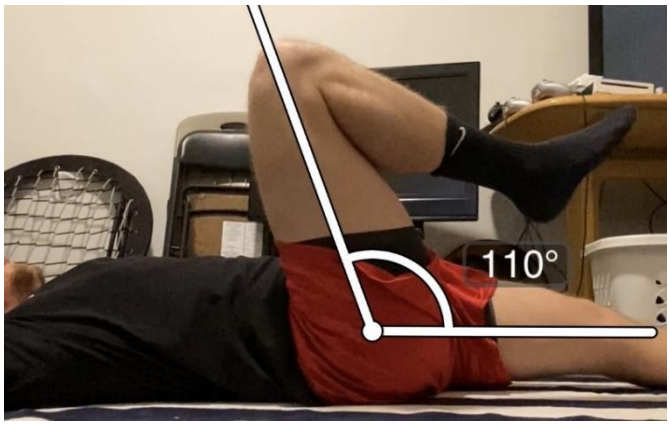
*Snapshots taken from the video provided by the land participant while performing the "hip abduction" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Water Participant

Left Knee to Chest

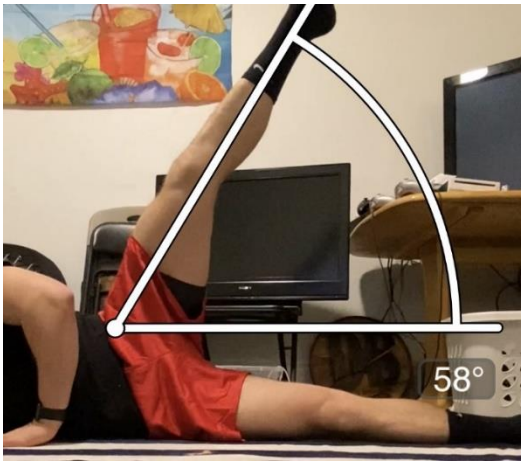


Right Knee to Chest



*Snapshots taken from the video provided by the water participant while performing the "pull knee to chest" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Left Hip Abduction

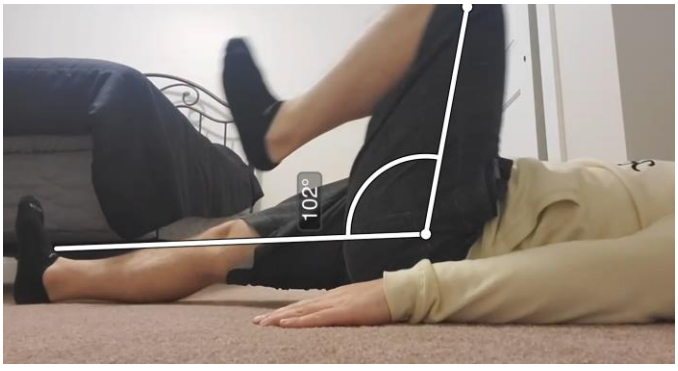


Right Hip Abduction

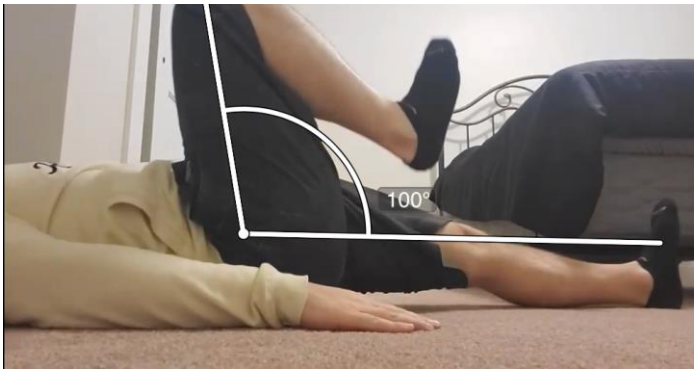
*Snapshots taken from the video provided by the water participant while performing the "hip abduction" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Control Participant

Left Knee to Chest

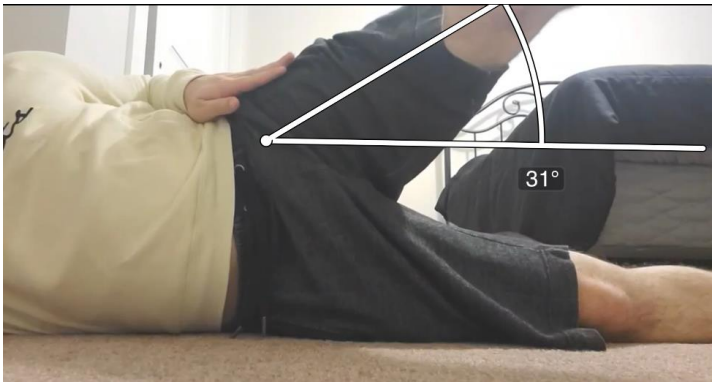


Right Knee to Chest

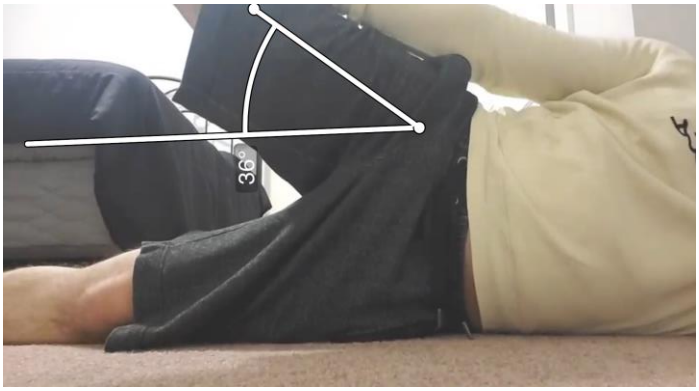


*Snapshots taken from the video provided by the control participant while performing the "pull knee to chest" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Left Hip Abduction



Right Hip Abduction



*Snapshots taken from the video provided by the control participant while performing the "hip abduction" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Table 4

Post intervention hip measurements

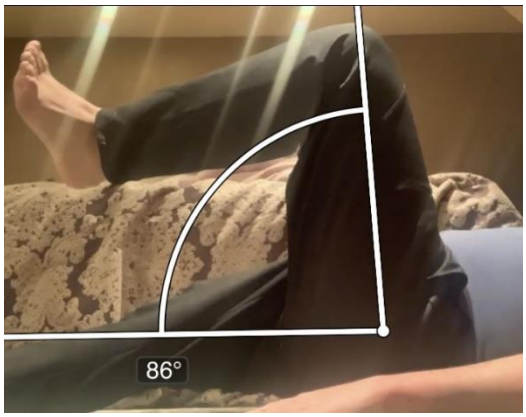
Date	Subject	Range of Motion Stretch	Range of Motion Measurement
3/4/2021	Land	Pull knee to chest	L: 86º R: 72º
		Hip abduction	L: 42º R: 50º
3/4/2021	Water	Pull knee to chest	L: 107º R: 105º
		Hip abduction	L: 65º R: 67º
3/4/2021	Control	Pull knee to chest	L: 105º R: 48º
		Hip abduction	L: 100º R: 57º

*This is a chart depicting the measurements in degrees of the left and right hip of each subject (land, water, and control). There were two range of motion stretches performed: pulling the knee to the chest and hip abduction. These measurements were taken from the videos provided by the three participants at the end of the two-week study period.

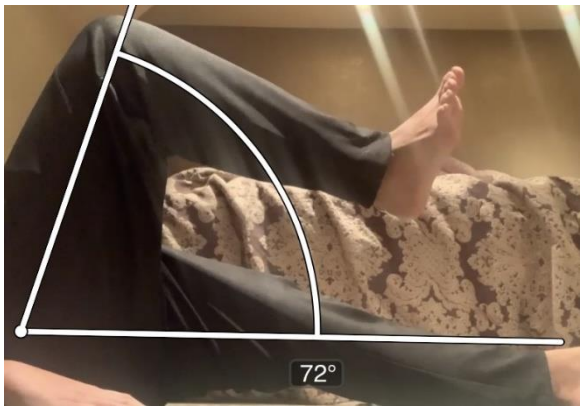
Participant Photos

Land Participant

Left Knee to Chest

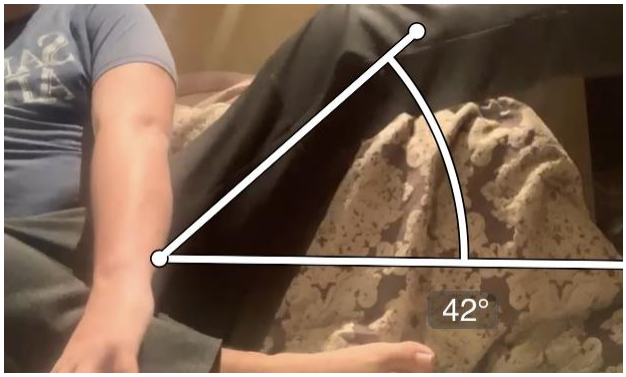


Right Knee to Chest



*Snapshots taken from the video provided by the land participant while performing the "pull knee to chest" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Left Hip Abduction

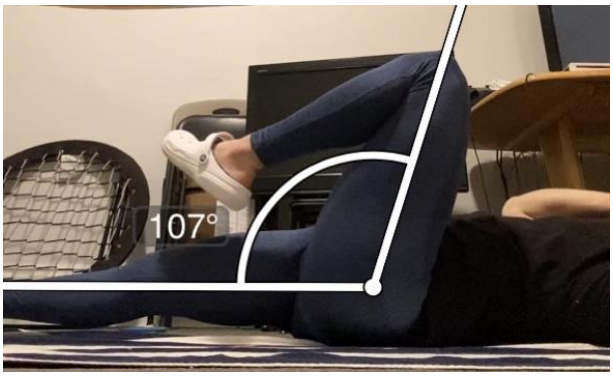


Right Hip Abduction

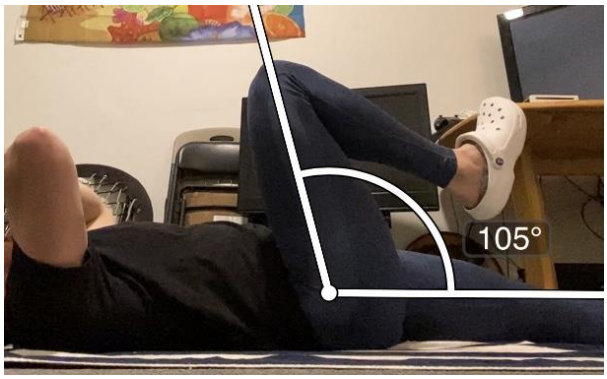
*Snapshots taken from the video provided by the land participant while performing the "hip abduction" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Water Participant

Left Knee to Chest

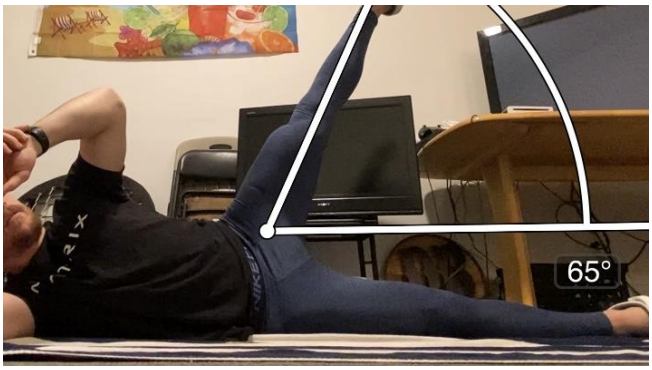


Right Knee to Chest

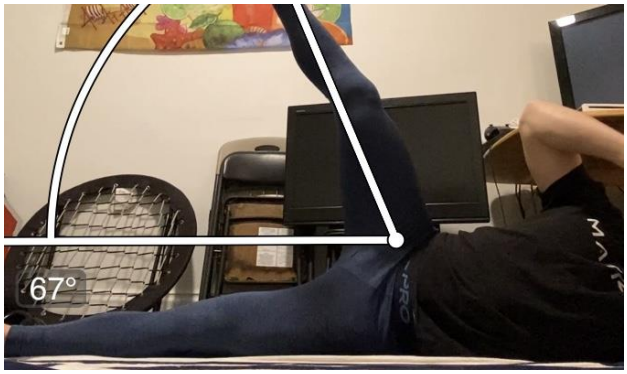


*Snapshots taken from the video provided by the water participant while performing the "pull knee to chest" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Left Hip Abduction



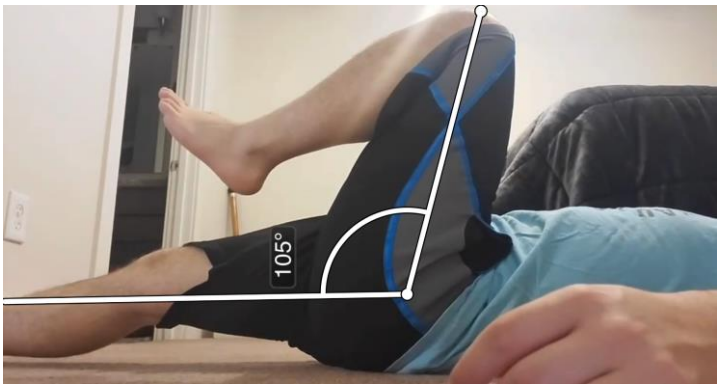
Right Hip Abduction



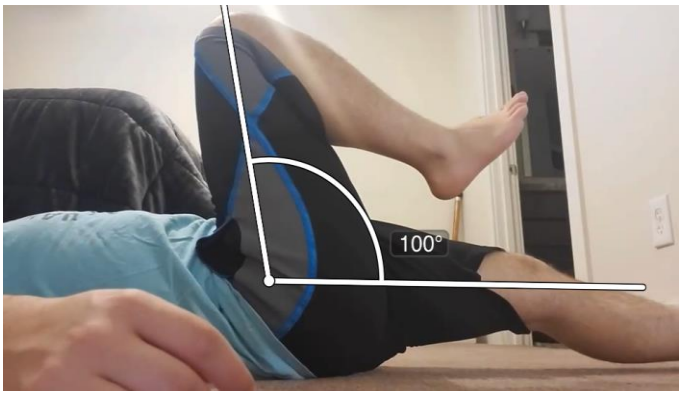
*Snapshots taken from the video provided by the water participant while performing the "hip abduction" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Control Participant

Left Knee to Chest



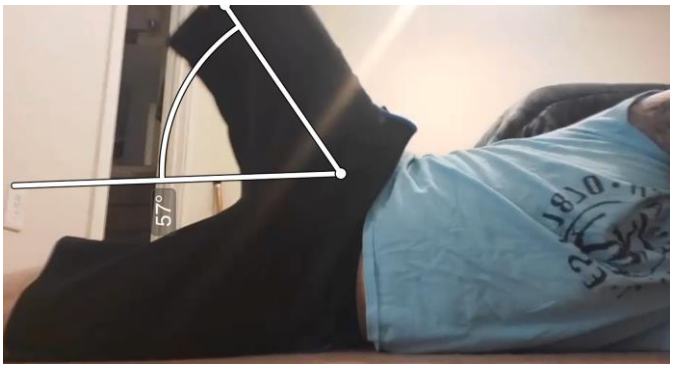
Right Knee to Chest



*Snapshots taken from the video provided by the control participant while performing the "pull knee to chest" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Left Hip Abduction

Right Hip Abduction



*Snapshots taken from the video provided by the control participant while performing the "hip abduction" stretch to show the range of motion (ROM) for the left and right hip. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Table 5

Pre intervention knee measurements

Date	Subject	Range of Motion Stretch	Range of Motion Measurement
2/21/2021	Land	Bending knee to glutes	L: 112º R: 87º
2/21/2021	Water	Bending knee to glutes	L: 103º R: 110º
2/21/2021	Control	Bending knee to glutes	L: 138º R: 136º

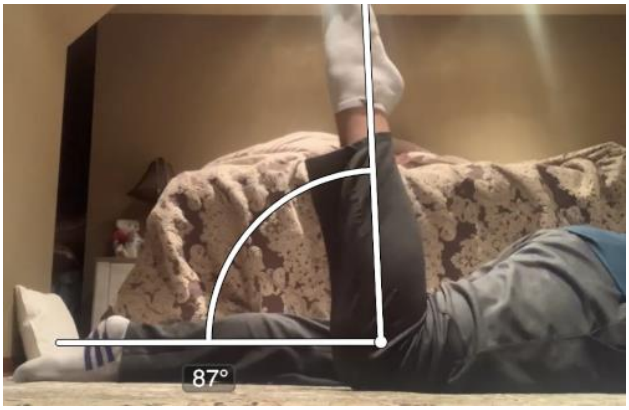
*This is a chart depicting the measurements in degrees of the left and right knee of each subject (land, water, and control). There was one range of motion stretch performed: bending the knee to the glutes. These measurements were taken from the videos provided by the three participants at the beginning of the two-week study period.

Participant Photos

Land Participant

Left Knee to Glutes

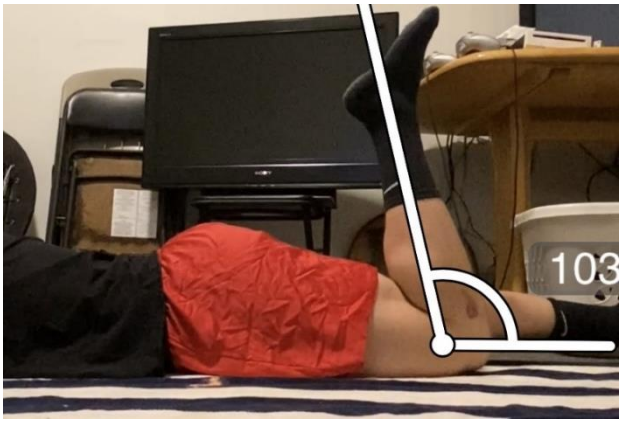
Right Knee to Glutes



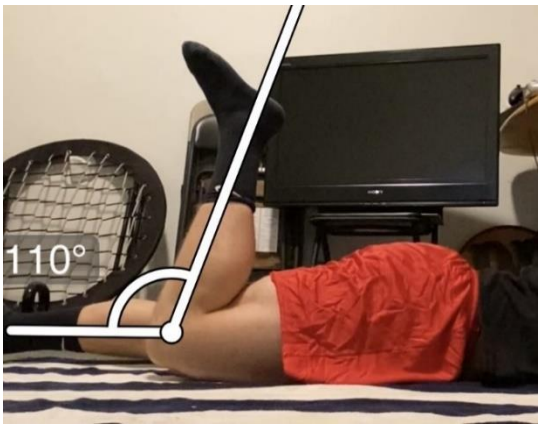
*Snapshots taken from the video provided by the land participant while performing the "bending knee to glutes" stretch to show the range of motion (ROM) for the left and right knee. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Water Participant

Left Knee to Glutes



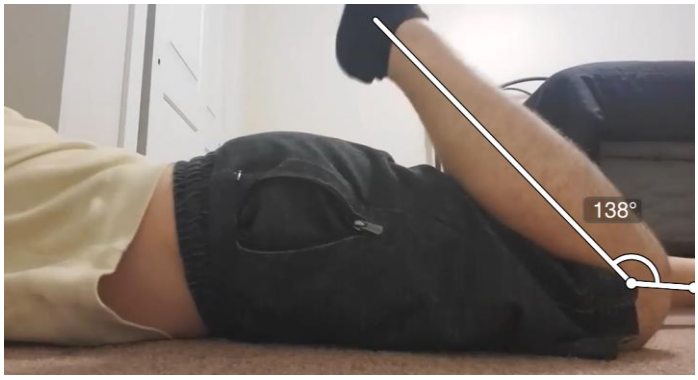
Right Knee to Glutes



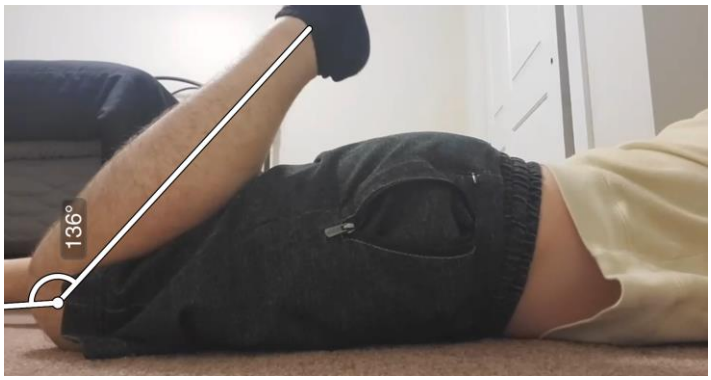
*Snapshots taken from the video provided by the water participant while performing the "bending knee to glutes" stretch to show the range of motion (ROM) for the left and right knee. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Control Participant

Left Knee to Glutes



Right Knee to Glutes



*Snapshots taken from the video provided by the control participant while performing the "bending knee to glutes" stretch to show the range of motion (ROM) for the left and right knee. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the beginning of the two-week period.

Table 6

Post intervention knee measurements

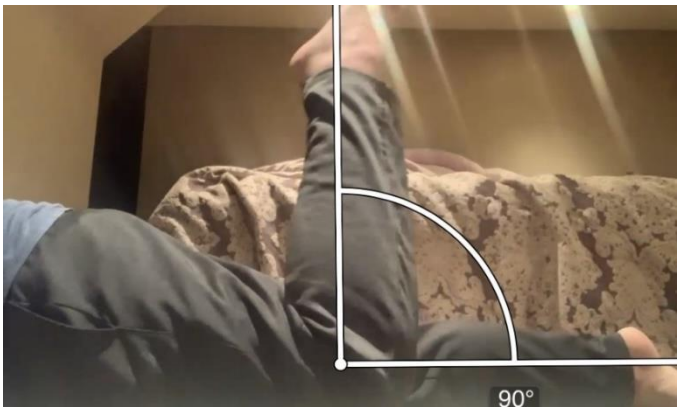
Date	Subject	Range of Motion Stretch	Range of Motion Measurement
3/4/2021	Land	Bending knee to glutes	L: 90º R: 112º
3/4/2021	Water	Bending knee to glutes	L: 109º R: 114º
3/4/2021	Control	Bending knee to glutes	L: 137º R: 141º

*This is a chart depicting the measurements in degrees of the left and right knee of each subject (land, water, and control). There was one range of motion stretch performed: bending the knee to the glutes. These measurements were taken from the videos provided by the three participants at the end of the two-week study period.

Participant Photos

Land Participant

Left Knee to Glutes

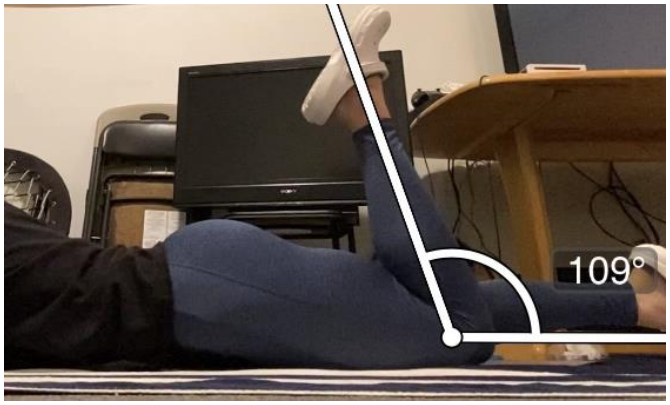


Right Knee to Glutes

*Snapshots taken from the video provided by the land participant while performing the "bending knee to glutes" stretch to show the range of motion (ROM) for the left and right knee. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Water Participant

Left Knee to Glutes



Right Knee to Glutes

*Snapshots taken from the video provided by the water participant while performing the "bending knee to glutes" stretch to show the range of motion (ROM) for the left and right knee. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Control Participant

Left Knee to Glutes

Right Knee to Glutes

*Snapshots taken from the video provided by the control participant while performing the "bending knee to glutes" stretch to show the range of motion (ROM) for the left and right knee. The lines shown are how the researchers calculated the degree of ROM using the Coach's Eye application. This is at the end of the two-week period.

Table 7.1

Land & Water Participants' Left Joint Values, Beginning and Ending Values – Grouped Range of Motion Stretch Values by Joint

	Land	**Water**
$Shoulder_1$	326	321
Hip_1	144	164
$Knee_1$	112	103
$Shoulder_2$	287	329
Hip_2	128	172
$Knee_2$	90	109

Chart describing the relationship between the range of motion within the shoulder, hip, and knee on the left side of the body. The values from the beginning and end of the two-week study for the left side of the body (shoulder, hip, and knee) were added together from the land and water participants. Shoulder1, Hip1, and Knee1 were from the beginning of the two weeks while Shoulder2, Hip2, and Knee2 were values from the end of the two weeks.

Table 7.2

Land & Water Participants' Right Joint Values, Beginning and Ending Values – Grouped Range of Motion Stretch Values by Joint

	Land	**Water**
$Shoulder_1$	312	313
Hip_1	146	170
$Knee_1$	87	110
$Shoulder_2$	196	312
Hip_2	122	172
$Knee_2$	112	114

Chart describing the relationship between the range of motion within the shoulder, hip, and knee on the right side of the body. The values from the beginning and end of the two-week study for the right side of the body (shoulder, hip, and knee) were added together from the land and water participants. Shoulder1, Hip1, and Knee1 were from the beginning of the two weeks while Shoulder2, Hip2, and Knee2 were values from the end of the two weeks.

Table 7.3

Land & Water Participants' Left and Right Joint Values, Beginning and Ending Values – Grouped Range of Motion Stretch Values by Joint

	Land	**Water**
$Shoulder_1$	638	634
Hip_1	290	334
$Knee_1$	199	213
$Shoulder_2$	483	641
Hip_2	250	344
$Knee_2$	202	223

Chart describing the combined relationship between the range of motion within the shoulder, hip, and knee on both sides of the body (right and left). The values from the beginning and end of the two-week study for both sides of the body (shoulder, hip, and knee) were added together from the land and water participants. Shoulder1, Hip1, and Knee1 were from the beginning of the two weeks while Shoulder2, Hip2, and Knee2 were values from the end of the two weeks.

No significant differences between land and water for left leg ($p = 0.86$) right leg ($p = 0.49$) and both legs ($p = 0.62$) were observed and are shown in figures 1.1 -1.3.

Figure 1.1

Relationship between the range of motion within the shoulder, hip, and knee on the left side of the body.

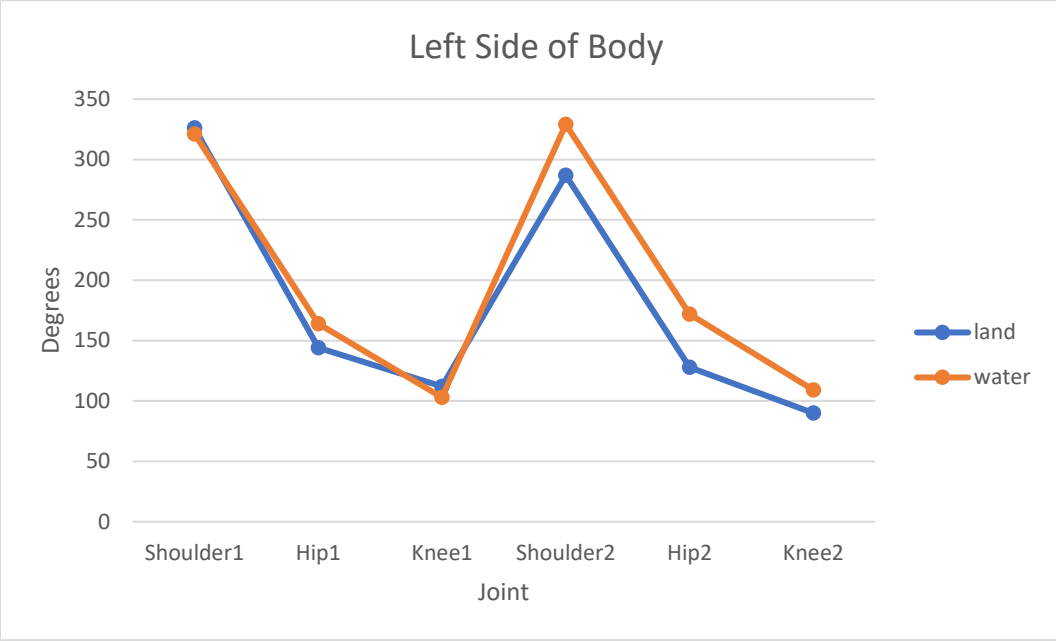


Figure 1.2

Relationship between the range of motion within the shoulder, hip, and knee on the right side of the body

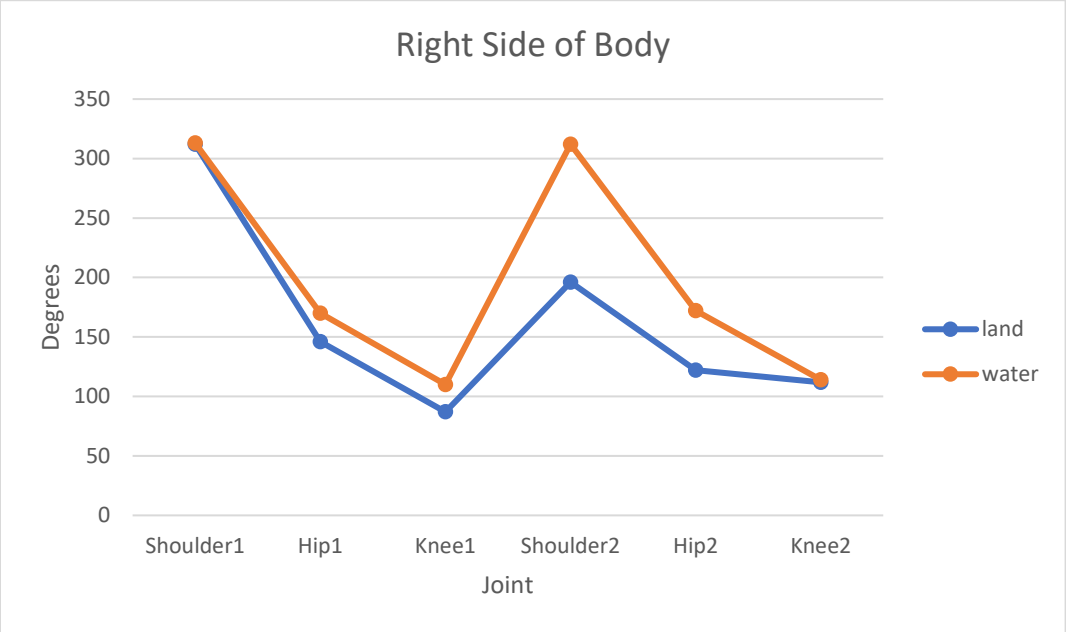
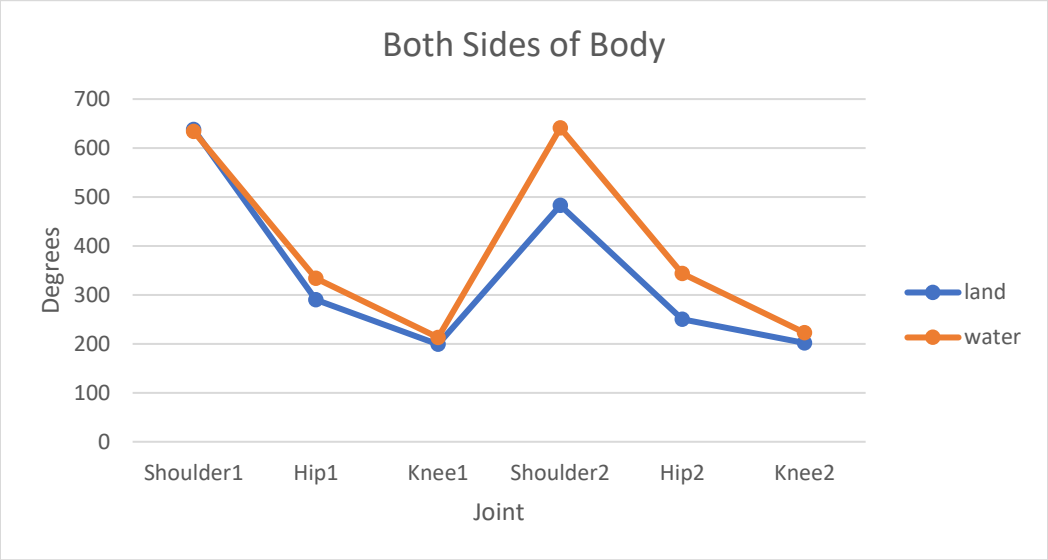


Figure 1.3

Relationship between the range of motion within the should, hip, and knee on both sides of the body



Part V: Discussion

In the several research articles that were studied, many were able to be compared to the results of this study. Similarly, this study noticed a greater increase in range of motion for the aquatic participant. Although it was not significant, it was still increasing. In a majority of the studies, Pérez de la Cruz (2020), Catalin, Nicolae, & Margit (2019), Ahmadi, Yalfani, & Gandomi (2019), and Kargarfard, M., Dehghadani, M., & Ghias, R. (2013), it was concluded that there were significant increases in range of motion with aquatic exercises. Additionally, it is important to note that in Catalin, Nicolae, & Margit (2019) there was a 10-day period that data was collected, among more data, and both studies observed increases in range of motion in that time frame. This proves that change in range of motion is able to be seen within a small timeframe such as 10 days. While there were many similarities, there were also several

differences. First of all, the studies were more often able to conclude that there was a significant increase in range of motion as opposed to this study. Additionally, a majority of the individuals in the studies (Pérez de la Cruz (2020), Catalin, Nicolae, & Margit (2019), Ahmadi, Yalfani, & Gandomi (2019), Villalta & Peiris (2013), and Kargarfard, M., Dehghadani, M., & Ghias, R. (2013)) were injured patients whereas this study involved healthy individuals. This may have affected the results due to injured patients potentially having more room for growth as opposed to healthy individuals already functioning at a working ability. While this is not researched upon, it could be a possibility.

No statistical significance was found in any of the pre and post measurements in this study. This may be due to the extremely small sample size as well as human error. There could have been human error by the participants while they were filming their range of motion stretches videos in addition to the researchers using the Coach's Eye (TechSmith Corporation, Okemos, MI) application to measure, in degrees, the range of motion of each of the three joints. The data collected using three subjects cannot be compared to larger studies of the same kind.

The sample size of this case study-style research was lacking. Due to only having three participants and limited in abilities to conduct the study, accurate and precise numbers were not obtained. Despite this, the study laid the foundation for a larger-scale study of the same nature. This study could be performed on a much larger scale. This could provide additional data to test the researchers' hypothesis. There was a slight decrease in degrees throughout the two-week duration of the study with the land participant. But, although results were not significant, a slight increase was demonstrated with the aquatic participant. The results were not supportive of the hypothesis due to the measurements not being significant, but they were still going in the correct

direction. This may conclude that a significant difference could be seen if there was a larger sample size, longer study time, and in person intervention.

This study faced many limitations due to its small sample size duration. The sample size was smaller than other studies in the literature. A small sample size could decrease a study's statistical accuracy and impact. There was not enough variability to get a clear, accurate conclusion to support the researchers' hypothesis. The researchers decreased the sample size to align with COVID-19 guidelines; therefore, less conclusive results were obtained. Another limitation mentioned was the length of time the study occurred. If given more time, an increase in range of motion may have been seen in the participants' joints. Muscles and tendons take time to adapt to new stressors and movements. The two-week time period given to the participants was not enough time for the researchers to see any significant increases or decreases in range of motion. Future research should include increasing sample size as well as increase in duration. Another potential variable that can be examined is different age groups and genders. While this study was completed with males in their 20s, it may be interesting to do the same study with females in their 20s to notice if there is a significant difference. The same can be said to increasing or decreasing the age population to discover if a certain group is more susceptible to gaining more range of motion. While this next variable could not be controlled due to face-to-face research being suspended, it would be interesting to replicate this experiment while adding in face-to-face intervention and constant supervision during exercises as well as utilizing a goniometer to measure the joints as opposed to using an application. This variable could possibly lead to more accuracy and less error due to more control over the whole process. Overall, with some changes to variables, new research could be branched off this study utilizing the same idea but modifying a few variables.

Part VII: Conclusion

The researchers hypothesized that an adult male between the ages of 20-19 years-old would have a higher increase in range of motion when performing a given set of exercises in water versus an adult male who performs the same exercises on land. This study looked at three adult males within a given age range. They were put into three groups: land group, water group, and control group. After a two-week time period, all values and results from the exercises and range of motion stretches were evaluated with statistically significant results were observed. However, to our knowledge, this is the first study comparing changes in ROM in healthy adult males comparing an aquatic and land-based exercise intervention. Replication of this study with more participants and extending the intervention duration may provide practical applications in this population for safely and effectively increasing ROM.

The researcher Miranda Gibel notes that while the study was limited in many ways due to COVID-19, the experiment was a great starting point for many new potential research studies. Being the first research study that she has completed, it had many important lessons embedded in the process. She learned that being thorough and meticulous is an important skill to utilize while conducting research. It is essential to time manage and pay attention to every detail along the way. The more details that are attended to, the easier the study can be controlled. She also learned the importance of face-to-face research and while this was not able to be practiced during the experiment, it was noted that future research like this one should be completed in person. While some research is able to be done completely virtual such as surveys, an experiment with specific people over a period of time should be monitored closely. This is strictly due to the fact that many variables were unable to be controlled, thus the room for error was large. Overall, this

study helped to expand Miranda's knowledge of conducting research and the process it requires. It will help exponentially when conducting future studies.

The researcher Sam Lawler notes that this study had many elements that allowed the researchers to explore the joints chosen and how exercising in water effects range of motion. The research data was difficult to obtain regarding the excessive use of technology. Despite this, the researchers were able to collect as accurate data as possible from the participating subjects. If this study was conducted using in-person research methods, then the data may have been different. From this study, Sam learned that the sample size and length of time the study went on were extremely important; however, the data collected was useful for further research. If this study could be repeated, the sample size and period of study would be increased. In conclusion, the data collection and communication between researchers and participants was exceptional despite the lack of human interaction face-to-face.

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Appendix A

Notice of Approval by The University of Akron Institutional Review Board

Office of Research Administration
Akron, OH 44325-2102

NOTICE OF APPROVAL

Date: 3/3/2021

To: Miranda Gibel and Sam Lawler

From: Kathryn A Watkins, IRB Administrator

IRB Number: 20210112

Title: Comparison of Range of Motion After Aquatic vs Land Exercises on Young Adult Men

Thank you for submitting your Application for Research Involving Human Subjects to the IRB for review. Your protocol represents minimal risk to subjects and has been approved.

Approval Category: Expedited 6 & 7

Approval Date: 2/19/2021

In addition, the following is/are approved:

- ☐ Research involving children
- ☐ Research involving prisoners
- ☐ Waiver of documentation of consent
- ☐ Waiver or alteration of consent

- Annual review of Expedited protocols is no longer required under the regulations; therefore, there is no expiration date on this approval.
- If changes are made to the protocol you must submit a Request for Change form for review and approval before the change is implemented.
- When the project is completed you must submit a Final Report to close the IRB file.
- If this research is being conducted for a master's thesis or doctoral dissertation, you must file a copy of this letter with the thesis or dissertation.
- All forms are available on the ORA website at http://www.uakron.edu/research/ora/compliance/irb/irbforms.dot
- CITI Certification is valid for three years. It is your responsibility to update your certification as needed. The link to the CITI home log-in screen is: https://www.citiprogram.org/

☑ Approved consent form(s) attached

Appendix B

Informed Consent Form

School of Sport Science & Wellness Education
Akron, OH 44325-5103
(330) 972-7473 Office
(330) 972-5293 Fax

Comparison of Range of Motion After Aquatic vs Land Exercises on Young Adult Men
Informed Consent Form
For Prospective Collection of Data/Information

You are invited to participate in a research study that will compare range of motion in the shoulders, hips, and knees between land exercises and water exercises. Three men between the ages of 20-29 years old will be examined. This research will be conducted by Samantha Lawler and Miranda Gibel, both are seniors majoring in Exercise Science with a concentration in Pre-Physical Therapy. The purpose of this research is to determine if there is any difference in range of motion between three men with one exercising on land, one in water, and one not exercising at all. This last subject will be the control group of this research.

After signing the informed consent form, you will undergo two weeks of six different range of motion exercises. The range of motion within the shoulders, hips, and knees will be measured using technology (i.e., pictures and videos). The types of range of motion movements include shoulder circumduction, hip abduction, hip adduction, hip flexion, hip extension, hip internal rotation, hip external rotation, knee flexion, and knee extension. You will follow the instructions sheet that was given to you to ensure your own safety while participating in these exercises and stretches. You will also log your progress onto the progress sheet given to you prior to the beginning of the two weeks. Under any circumstance you may stop the measurements or exercises at any time. You are not required to finish if you do not feel comfortable with the exercises or measurements.

You are required to wear loose fitting clothing such as a t-shirt, tank top, and/or shorts to allow for accurate measurements of the chosen joints. This will allow you to reach your full range of motion for each measurement. Shoes are not required in the water during the exercises.

Participants must be a male between the ages of 20-29 years old. You are not eligible to participate in this research project if you are under the age of 20 or above the age of 29.

Range of motion exercises and measurements have minimal risks associated with them. Participants must be careful to not overstretch their muscles. Participants are instructed to only stretch to slight discomfort and not to the point of pain.

You may benefit from this study by increasing your knowledge of range of motion exercises and what it means to increase the range of motion within a vital joint of the body.

All private information collected by the researchers regarding the participants will be kept confidential. This includes all images, videos, and other private information that could identify the participants.

This study has been reviewed and approved by The University of Akron Institutional Review Board (IRB). If you have any questions about your rights as a research participant, you may call the IRB at (330) 972-7666.

This information has been explained by one or either of the following:

Samantha Lawler
Miranda Gibel

I understand that they will answer any questions I have concerning the procedures of this study at any time by contacting them via the information listed below. I also understand that my participation in this study is entirely voluntary, that I define myself as a male between the ages of 20-29, have not had an injury that is currently limiting my range of motion, and that I may decline to enter this study or withdraw from it at any time without consequences. I understand that the investigators may terminate my participation in the study at any time.

Contact information about the study:

Samantha Lawler	(740) 586-1180	sll96@uakron.edu
Miranda Gibel	(440) 822-7794	mlg135@uakron.edu

I understand that I am not receiving any compensation for participating in this study.

Signature of Research Subject_____ Date_____

Signature of Witness_____ Date_____

Appendix C

The Physical Activity Readiness Questionnaire

2021 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1) Has your doctor ever said that you have a heart condition ☐ **OR** high blood pressure ☐?	☐	☐
2) Do you feel pain in your chest at rest, during your daily activities of living, **OR** when you do physical activity?	☐	☐
3) Do you lose balance because of dizziness **OR** have you lost consciousness in the last 12 months? Please answer **NO** if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
5) Are you currently taking prescribed medications for a chronic medical condition? **PLEASE LIST CONDITION(S) AND MEDICATIONS HERE:** _____	☐	☐
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer **NO** if you had a problem in the past, but it **does not limit your current ability** to be physically active. **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
7) Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

If you answered NO to all of the questions above, you are cleared for physical activity.
Please sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow Global Physical Activity Guidelines for your age (https://www.who.int/publications/i/item/9789240015128).
- You may take part in a health and fitness appraisal.
- If you are over the age of 45 yr and NOT accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.
- If you have any further questions, contact a qualified exercise professional.

PARTICIPANT DECLARATION

If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness center may retain a copy of this form for its records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME _____ DATE _____

SIGNATURE _____ WITNESS _____

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER _____

If you answered YES to one or more of the questions above, COMPLETE PAGES 2 AND 3.

Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ at www.eparmedx.com before becoming more physically active.
- Your health changes - answer the questions on Pages 2 and 3 of this document and/or talk to your doctor or a qualified exercise professional before continuing with any physical activity program.

 1 / 4

01-11-2020

2021 PAR-Q+

FOLLOW-UP QUESTIONS ABOUT YOUR MEDICAL CONDITION(S)

1. Do you have Arthritis, Osteoporosis, or Back Problems?

If the above condition(s) is/are present, answer questions 1a-1c If **NO** ☐ go to question 2

1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	YES ☐ NO ☐
1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	YES ☐ NO ☐

2. Do you currently have Cancer of any kind?

If the above condition(s) is/are present, answer questions 2a-2b If **NO** ☐ go to question 3

2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and/or neck?	YES ☐ NO ☐
2b.	Are you currently receiving cancer therapy (such as chemotheraphy or radiotherapy)?	YES ☐ NO ☐

3. Do you have a Heart or Cardiovascular Condition? This includes Coronary Artery Disease, Heart Failure, Diagnosed Abnormality of Heart Rhythm

If the above condition(s) is/are present, answer questions 3a-3d If **NO** ☐ go to question 4

3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
3b.	Do you have an irregular heart beat that requires medical management? (e.g., atrial fibrillation, premature ventricular contraction)	YES ☐ NO ☐
3c.	Do you have chronic heart failure?	YES ☐ NO ☐
3d.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	YES ☐ NO ☐

4. Do you currently have High Blood Pressure?

If the above condition(s) is/are present, answer questions 4a-4b If **NO** ☐ go to question 5

4a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
4b.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer **YES** if you do not know your resting blood pressure)	YES ☐ NO ☐

5. Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes

If the above condition(s) is/are present, answer questions 5a-5e If **NO** ☐ go to question 6

5a.	Do you often have difficulty controlling your blood sugar levels with foods, medications, or other physician-prescribed therapies?	YES ☐ NO ☐
5b.	Do you often suffer from signs and symptoms of low blood sugar (hypoglycemia) following exercise and/or during activities of daily living? Signs of hypoglycemia may include shakiness, nervousness, unusual irritability, abnormal sweating, dizziness or light-headedness, mental confusion, difficulty speaking, weakness, or sleepiness.	YES ☐ NO ☐
5c.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, **OR** the sensation in your toes and feet?	YES ☐ NO ☐
5d.	Do you have other metabolic conditions (such as current pregnancy-related diabetes, chronic kidney disease, or liver problems)?	YES ☐ NO ☐
5e.	Are you planning to engage in what for you is unusually high (or vigorous) intensity exercise in the near future?	YES ☐ NO ☐

01-11-2020

2021 PAR-Q+

6. **Do you have any Mental Health Problems or Learning Difficulties?** This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome

If the above condition(s) is/are present, answer questions 6a-6b If **NO** ☐ go to question 7

6a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
6b.	Do you have Down Syndrome **AND** back problems affecting nerves or muscles?	YES ☐ NO ☐

7. **Do you have a Respiratory Disease?** *This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure*

If the above condition(s) is/are present, answer questions 7a-7d If **NO** ☐ go to question 8

7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
7b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?	YES ☐ NO ☐
7c.	If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week?	YES ☐ NO ☐
7d.	Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?	YES ☐ NO ☐

8. **Do you have a Spinal Cord Injury?** *This includes Tetraplegia and Paraplegia*

If the above condition(s) is/are present, answer questions 8a-8c If **NO** ☐ go to question 9

8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
8b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?	YES ☐ NO ☐
8c.	Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?	YES ☐ NO ☐

9. **Have you had a Stroke?** *This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event*

If the above condition(s) is/are present, answer questions 9a-9c If **NO** ☐ go to question 10

9a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
9b.	Do you have any impairment in walking or mobility?	YES ☐ NO ☐
9c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?	YES ☐ NO ☐

10. **Do you have any other medical condition not listed above or do you have two or more medical conditions?**

If you have other medical conditions, answer questions 10a-10c If **NO** ☐ read the Page 4 recommendations

10a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months **OR** have you had a diagnosed concussion within the last 12 months?	YES ☐ NO ☐
10b.	Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?	YES ☐ NO ☐
10c.	Do you currently live with two or more medical conditions?	YES ☐ NO ☐

PLEASE LIST YOUR MEDICAL CONDITION(S) AND ANY RELATED MEDICATIONS HERE: _____

_____

GO to Page 4 for recommendations about your current medical condition(s) and sign the PARTICIPANT DECLARATION.

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2021 PAR-Q+

If you answered NO to all of the FOLLOW-UP questions (pgs. 2-3) about your medical condition, you are ready to become more physically active - sign the PARTICIPANT DECLARATION below:

- It is advised that you consult a qualified exercise professional to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually - 20 to 60 minutes of low to moderate intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate intensity physical activity per week.
- If you are over the age of 45 yr and **NOT** accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.

If you answered **YES** to **one or more of the follow-up questions** about your medical condition:

You should seek further information before becoming more physically active or engaging in a fitness appraisal. You should complete the specially designed online screening and exercise recommendations program - the **ePARmed-X+ at www.eparmedx.com** and/or visit a qualified exercise professional to work through the ePARmed-X+ and for further information.

Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ **at www.eparmedx.com** before becoming more physically active.
- Your health changes - talk to your doctor or qualified exercise professional before continuing with any physical activity program.

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The authors, the PAR-Q+ Collaboration, partner organizations, and their agents assume no liability for persons who undertake physical activity and/or make use of the PAR-Q+ or ePARmed-X+. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.

PARTICIPANT DECLARATION

- All persons who have completed the PAR-Q+ please read and sign the declaration below.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness center may retain a copy of this form for records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME _____ DATE _____

SIGNATURE _____ WITNESS _____

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER _____

For more information, please contact
www.eparmedx.com
Email: eparmedx@gmail.com

Citation for PAR-Q+
Warburton DER, Jamnik VK, Bredin SSD, and Gledhill N on behalf of the PAR-Q+ Collaboration. The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and Electronic Physical Activity Readiness Medical Examination (ePARmed-X+). Health & Fitness Journal of Canada 4(2):3-23, 2011.

The PAR-Q+ was created using the evidence-based AGREE process (1) by the PAR-Q+ Collaboration chaired by Dr. Darren E. R. Warburton with Dr. Norman Gledhill, Dr. Veronica Jamnik, and Dr. Donald C. McKenzie (2). Production of this document has been made possible through financial contributions from the Public Health Agency of Canada and the BC Ministry of Health Services. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or the BC Ministry of Health Services.

Key References

1. Jamnik VK, Warburton DER, Makarski J, McKenzie DC, Shephard RJ, Stone J, and Gledhill N. Enhancing the effectiveness of clearance for physical activity participation; background and overall process. APNM 36(S1):S3-S13, 2011.
2. Warburton DER, Gledhill N, Jamnik VK, Bredin SSD, McKenzie DC, Stone J, Charlesworth S, and Shephard RJ. Evidence-based risk assessment and recommendations for physical activity clearance; Consensus Document. APNM 36(S1):S266-s298, 2011.
3. Chisholm DM, Collis ML, Kulak LL, Davenport W, and Gruber N. Physical activity readiness. British Columbia Medical Journal. 1975;17:375-378.
4. Thomas S, Reading J, and Shephard RJ. Revision of the Physical Activity Readiness Questionnaire (PAR-Q). Canadian Journal of Sport Science 1992;17:4 338-345.

PRINT FORM RESET FORM

 4/4
01-11-2020

Appendix D

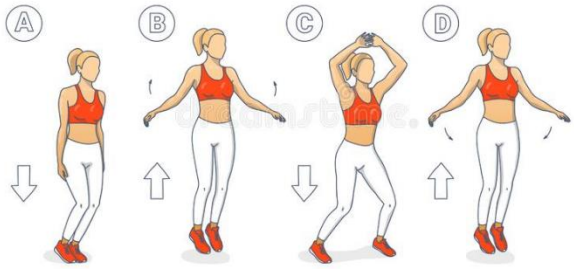
Exercises for Participants Document

Exercises: 5x a week

Land-Based and Aquatic Group

1. Jumping Jacks

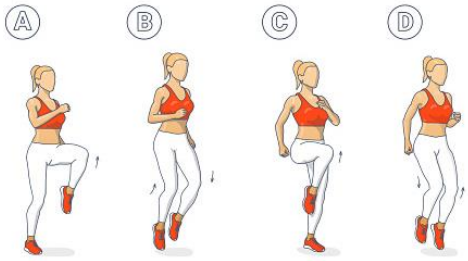
Land



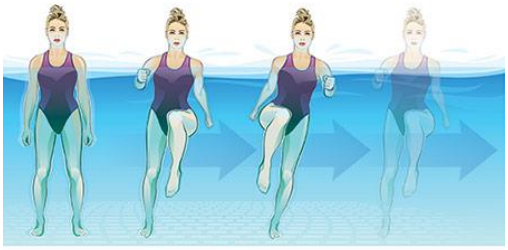
Water

2. High Knees

Land



Water



3. Glute Kick

Land

Water

4. Gate Openers

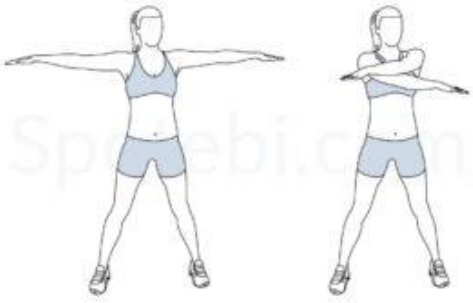
Land

Water

No picture, do the same thing as the land exercise but in water.

5. Cross Body Arm Swings

Land



Water

6. Arm Circles

Land

Water

(no weight)

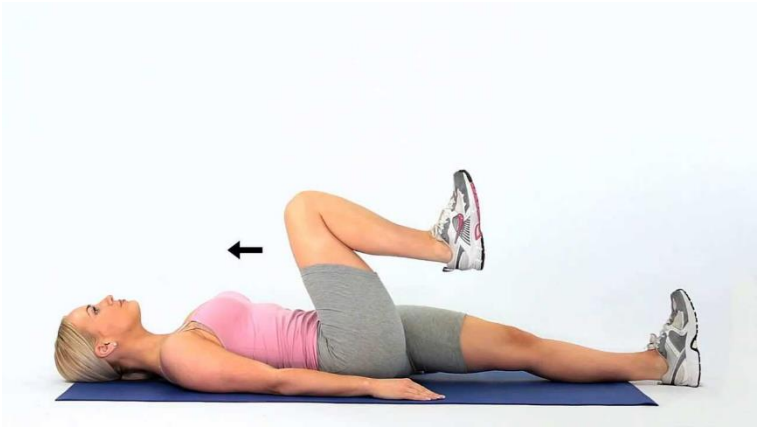
Appendix E

Stretches for Participants Document

Range of Motion Stretches: 5x a week

All Groups – Take photos or videos of each one

1. Hip Flexion w/ Knee Bent



2. Hip Abduction

3. Knee Flexion

4. Hand Behind Back (Overhead)

5. Hand Behind Back (Under)

Appendix F

Exercise Log for Participants

Participant Data Collection Log

Name: _____ **Height: _____** lbs.
Start Date: _____ / _____ / _____ **Weight: _____** ft. **_____** in.

Exercises: Each day write the date you are completing the exercises and initial in the box upon completing them.

Week / Day	Date	Exercise	Sets / Repetitions	Comments	Initials
Week 1, Day 1		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 1, Day 2		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 1, Day 3		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 1, Day 4		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 1, Day 5		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 2, Day 1		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 2, Day 2		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 2, Day 3		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 2, Day 4		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		
Week 2, Day 5		Jumping Jacks High Knees Gluteal Kicks Gate Openers Cross Body Arm Swings Arm Circles	3 sets, 10 repetitions		

Range of Motion: When completing these stretches, move the body part to the point of tightness, not pain. There should be no pain while doing these stretches. On each day, write the date and sign your initials in the box after taking a video or picture of yourself completing the stretch. Send the video or picture to mlg135@uakron.edu or sll96@uakron.edu. The first row, your "starting point" should be documented prior to doing any prescribed exercises.

Week / Day	Date	Shoulder Flexibility -Reach behind back stretch				Hip Flexibility -Knee pull into chest -Lay on side, leg away from midline		Measure of Knee Flexibility -Lay on stomach, bend knee to glute	Comments
		Left Hand Over	Left Hand Under	Right Hand Over	Right Hand Under	Laying on back, pull one knee into chest at a time	Laying on side, move leg away from midline, both sides	Laying on stomach, bend knee as far as possible to glute without assistance	
Starting Point									
Week 1, Day 1									
Week 1, Day 2									
Week 1, Day 3									
Week 1, Day 4									
Week 1, Day 5									
Week 2, Day 1									
Week 2, Day 2									
Week 2, Day 3									
Week 2, Day 4									
Week 2, Day 5									