Thank you, Monica. Good morning. Today I'll be presenting the research process and rationale behind my extended investigation, "Does bilateral training in young water polo athletes increase performance?" Water polo is a brutal sport, with underwater and intense competition on the surface. Water polo athletes need specialized speed, strength, flexibility, and endurance in order to win and to stay afloat. Athletes can swim up to 1.6 kilometers per game, lasting 28 minutes. All whilst attacking, defending, and not being able to touch the floor of the pool.

Athletes are only as good as their training, and this is where my research steps in. The aim is to determine whether bilateral training increases the performance of young water polo athletes. Bilateral training is the process of training both sides of the body simultaneously, whereas unilateral training focuses on one side at a time. In this research, young athletes range between 14 and 18 years old. Previous research by Ramirez-Campillo and colleagues in 2015 and then Lee and colleagues in 2017 both found that bilateral training brought about positive effects for stroke survivors and soccer players, respectively. In terms of water polo performance, [inaudible 00:01:21] in 2014 and in 2015. Both found that dry land training, meaning out of the water, increased performance.

In 2019, [inaudible 00:01:33] and colleagues found that water polo athletes developed a heightened bilateral coordination compared to nonathletes. The graph on the left represents the final position error. The lower the score, the higher the bilateral coordination. The graph on the right represents research by [inaudible 00:01:48] and colleagues in 2017 and shows how the swimming ability of water polo athletes was increased due to strength training. These findings made research surrounding bilateral training in water polo players instrumental, not only for improving their performance, but also performance of athletes in other sports similar to water polo like European handball, as Porter stated in 1990. This research considered, this still remains a poor sea of research looking into the effect of bilateral training on performance of young water polo athletes. The initial hypothesis was that both bilateral and unilateral groups would experience an increase in performance. Expanding from this, it was predicted that the bilateral group present a greater increased performance compared to the unilateral group.

There were four main stages to my research. One, I assembled 14 male participants from Victorian High School water polo team. They signed consent forms and received my language statements. Following this, sports experts were contacted. Jono Wallace Smith is a physical preparation coach for water polo at Victorian Institute of Sport. Jono provided insight to what the best male water polo athletes do for training and a framework to help our participants. Slobodan Macic is a state water polo coach for Victoria and coaches the school water polo team. Slobodan emphasizes how vital it is for young water polo athletes to focus on strength training as well as flexibility.

Two, initial in water pretesting stages planned to involve four different important tests which measured performance. These were throwing velocity, hand grip strength, 20 meter swim and vertical thrust. However, due to COVID-19 restrictions by the Department of Education on the use of indoor pools, the in water pretest had to be changed to dry land. The dry land equivalent tests were throwing velocity, 400 meter run, vertical jump and hand group strength. An additional fifth test, a three kilogram med ball throw, was added as recommended by Jono Wallace Smith who vetted all dry land testing. Due to hand group strength and throwing velocity being tested on both sides of the body, nondominant and dominant results were recorded. The dominant arm is the participant's preferred arm.

Three, after completing the pretest, participants post tests... Sorry, participants were randomly divided into two groups representing unilateral and bilateral training groups. This was done so the increase in performance was due to a specific type of training rather than any regular training regime. Each group received a dry land training program with video tutorials. For four weeks, each participant completed one and a half hours of training comprised of two 45 minute sessions. The first two weeks were strengthening sessions. The last two weeks were flexibility sessions. After four weeks of training participants completed post tests.

Four, in order to analyze the results from pre and post test data, the data was compared in three stages using a T test, which indicates statistical significance. A T test provides a P value, which shows a percentage of results that are due to chance. If less than 5% of results are due to chance, then results are considered to be statistically significant. Results were analyzed in three stages. The first stage compared bilateral pre and post testing, the second compared unilateral pre and post testing, and the third compared bilateral and unilateral results. Ethical rights concerning voluntary participation, withdrawal rights, and informed consent were all obeyed. The no-harm principle was adhered to throughout the experiment. In line with the National Statement on Ethical Conduct in Human Research, this research is considered to be low risk.

All seven tests from the bilateral group showed an increase in performance. However, after applying a T test three tests were statistically significant. These were nondominant velocity, nondominant hand group strength and dominant hand group strength. In addition, med ball throw showed not quite statistically significant increase. Like the bilateral group, the unilateral group also had all seven tests show an increase in performance, with nondominant velocity, dominant velocity dominant hand group strength, and med ball throw all being statistically significant. To analyze our results, a T test was conducted across both groups' pretests, which showed no initial difference. This was crucial, as before the intervention the groups were at the same level, because when a further T test was conducted, non-dominant hand group strength was found to have not quite statistically significant increase, which was just above the accepted threshold.

The group's average increase in percentage for each test was analyzed, which showed no statistical significance. Of the eight measures, which included the seven tests and the average, the bilateral group outperform the unilateral group five to three. To account for any external factors that may have increased performance, participants' extra training hours were tracked throughout the intervention. Results showed the amount of extra training hours completed over the course of the intervention had no correlation to their improvement in performance. All 14 tests from both groups' pretests showed an increase in performance, with seven tests being statistically significant. This finding validates the study by [inaudible 00:07:00] colleagues in 2011 to show that bilateral training can increase performance.

Although no clear difference between the two training groups was observed, non-dominant hand group strength outlined a not quite statistically significant increase. Though this does not clearly determine whether bilateral training is more effective than unilateral training, it does indicate that further research must be conducted. With no correlation to the number of extra training hours completed over the course of intervention and participants' increases in performance, natural maturation or body growth could have an influence. Although this would be logical to assume, [inaudible 00:07:33] and colleagues in 1978 showed that muscle strength is not affected. Due to COVID-19 restrictions by the Department of Education, there was a delay of one week from the completion of the training program to post testing.

Despite this, D training, also known as not training, does not affect strength. As Mujika and Padilla showed in 2001, muscle strength can grow and change for up to one month. This research confirms that bilateral training increased the performance of young water polo athletes, in line with studies done by Lee and colleagues in 2021, [inaudible 00:08:07] and colleagues in 2011 and Ramirez-Campillo and colleagues in 2015 to support the indication that bilateral training will benefit athletes in other sports. The size and sample space and time constraints to experiment does not limit legitimacy and validity of the results, as established by Bloomfield and colleagues in 1990 and Ramirez-Campillo and colleagues in 2015, respectively. The location, gender and age or sample space does limit generalizability of the findings across the broader population of water polo athletes.

As previously mentioned, the initial method was severely impacted due to government restrictions. As gym and pool access was prohibited, the initial in water testing was revised to dry land testing. This modification eliminated the ability to measure certain in water performance aspects, which included swimming ability and vertical thrust stability. With this research having yielded promising results, further research into the effect of bilateral training better draw clear and accurate conclusions with the optimum methodology. This will include in water testing and the use of gym equipment in the training program. As bilateral training was shown to increase performance of my participants, the aim and hypothesis of this research was achieved. Both groups were found to have been positively impacted, however, when compared showed little evidence suggesting that one training is more successful in increasing performance than the other. All things considered, water polo is a tough sport and any increase in your performance can determine your success. Thank you.