**Introduction**

-add some information about SSC

Stretching is deemed to be a critical aspect of athletic preparation and performance, particularly in activities requiring explosive power, sudden changes in speed and direction. To help get blood moving throught the muscle and also reduce the potential of injury. The ability to generate forceful movements through the body beginning in the lower, can be measured through vertical jump height, this provides some essential insights into an individual’s muscular strength, coordination, and motor control. Vertical jump performance is not only a valuable metric for athletes in sports like cheerleading (just added in to touch on original experiment, can remove), basketball, volleyball, but it also plays a significant role in everyday functional tasks, such as climbing stairs, lifting objects, and maintaining overall mobility.

Research has previously explored the effects of different stretching protocols on vertical jump performance, particularly the comparison between static stretching (SS) and dynamic stretching (DS). Static stretching typically involves holding a muscle in an elongated position for an extended period, usually between 10 to 30 seconds. This method has been shown to improve flexibility and increase range of motion, but recent studies suggest that it may have a negating effect on activities requiring explosive power. Conversely, dynamic stretching involves controlled, repetitive movements that mimic the activity to be performed. This type of stretching increases blood flow, enhances activation of tbe muscles, and has been shown to better prepare athletes for power-based movements.

For instance, Fletcher's (2010) study demonstrated that fast dynamic stretching had a more significant positive impact on vertical jump performance compared to slower dynamic stretching, suggesting that the velocity of stretching movements can influence performance outcomes. This highlights the importance of not only the type of stretching but also the intensity and speed at which it is performed. Similarly, Behm and colleagues (2021) emphasized the role of the stretch-shortening cycle (SSC) in enhancing dynamic performance, including jumping, by optimizing force production and energy efficiency during muscle contraction.

Furthermore, the use of ballistic stretching, a more aggressive form of dynamic stretching, has shown to be more effective than static stretching in improving jump performance, particularly in trained athletes. Bacurau et al. (2009) found that ballistic stretching led to greater improvements in flexibility and jump height in a group of trained runners. These findings support the notion that dynamic movements which replicate the intensity of the sport or activity may be superior for preparing the body for high-power outputs.

The inclusion of arm swings in dynamic movements has also been shown to significantly increase jump height by further optimizing the SSC, as noted by Gillen et al. (2022). Their research highlighted how the integration of upper body movements can contribute to overall performance, reinforcing the complexity of the neuromuscular interactions involved in vertical jumping.

Despite the wealth of research on stretching and its effects on performance, inconsistencies remain in the findings. Some studies suggest that static stretching may impair power output, while others highlight the benefits of dynamic stretching for activities requiring explosive strength. These discrepancies can be attributed to variations in study design, participant demographics, and stretching protocols. This study aims to address these gaps by employing a randomized controlled cross-over design that directly compares the two stretching modalities under controlled conditions.

We also aim to further investigate the effects of static and dynamic stretching on vertical jump performance using a randomized controlled cross-over design. By comparing the two stretching modalities in adults with varying levels of athleticism, this study seeks to address some of the inconsistencies found in previous research and provide more definitive conclusions. The findings of this study are intended to inform not only athletes but also individuals seeking to optimize their physical performance and health in daily life.

**Methods**

**Study Design**

This study employed a randomized controlled cross-over design to compare the effects of static stretching (SS) and dynamic stretching (DS) on vertical jump performance. Participants were divided into three groups: Group A (SS), Group B (DS), and Group C (no stretch/control). Each group participated in all three conditions over three testing sessions, ensuring that every participant acted as their own control, thereby eliminating individual differences in performance. The study was conducted over consecutive days to minimize the impact of external factors such as temperature, humidity, or participant fatigue.

**Participants**

A total of 10-15 participants? (confirm) were recruited from the local community. Participants varied in levels of athleticism and were required to engage in regular physical activity, including jumping exercises. All participants provided informed consent prior to the study and completed a health screening questionnaire to ensure they met the inclusion criteria (e.g., physically fit, no current injuries preventing jumping).

**Experimental Protocol**

The experiment was conducted in a consistent (confirm location) environment, with testing occurring at roughly the same time of day for each participant to control for variations in external conditions such as ambient temperature. Participants wore light-weight sports clothing and performed the tests without shoes, although socks were allowed. The testing procedure was as follows:

1. **Warm-up**: All participants completed a standardized three-minute warm-up on a rowing ergometer (approximately 500 meters) or equivalent light aerobic warm-up (e.g., jogging shuttles) to elevate heart rate without inducing fatigue.
2. **Pre-Stretch Vertical Jump Test**: After warming up, participants performed three vertical jump attempts using (Confirm method of use). The highest jump was recorded as the baseline measurement.
3. **Stretching Protocol:**

* **Static Stretching (SS)**: Participants in the SS group performed static stretches targeting the major leg muscles (hamstrings, quadriceps, and calves). Each stretch was held for 30 seconds without bouncing, and the protocol lasted three minutes.
* **Dynamic Stretching (DS)**: Participants in the DS group performed dynamic stretches targeting the same muscle groups. The dynamic stretches involved controlled movements such as knee-grab glute stretches and calf pumps, repeated for three minutes.
* **Control (No Stretch, NS)**: Participants in the control group rested passively for three minutes.

1. **Post-Stretch Vertical Jump Test**: After completing the stretching protocols, participants performed another set of three vertical jumps using the (confirm method), with the highest jump recorded.

Each group underwent all three stretching conditions across three separate testing sessions, ensuring comprehensive data collection for each protocol.

**Equipment and Procedures**

The primary equipment used for the study included (Confirm Equipment/method) to measure jump height, a rowing ergometer for the warm-up, and a measuring tape for assessing participants' reach. The (method of testing) was adjusted for each participant by \_\_\_\_\_\_\_\_\_\_ Participants performed the jump with a controlled semi-squat, followed by a rapid extension of the legs and arms to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at the peak of their jump.

The testing environment was kept consistent, with daily temperatures recorded to ensure uniform conditions across all sessions. The experiment was conducted indoors on a firm floor to provide a stable and safe jumping surface

Schematic Diagram:

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**Data Collection and Analysis**

Data was collected and organized in a CSV file for statistical analysis using R Statistical Software (v4.2.3). Descriptive statistics, including mean, median, standard deviation, and range, were calculated….. add to when results have been collected

**Key Issues and Considerations**

* **Participant Fatigue**: To minimize fatigue, each session was conducted on consecutive days, and participants were given ample rest between jumps.
* **Consistency of Conditions**: All tests were conducted in a controlled indoor environment, and participants were instructed to maintain consistent routines (e.g., similar sleep and nutrition patterns) to avoid variability in performance due to external factors.

**More to add**