Stamps Impact Prize Application
The Impact of the Menstrual Cycle Phases on Upper Extremity Injury Risk in Female Athletes
Emma Cochran

A. **Student Information:**

Students Name: Emma Cochran
Classification: Junior
Major: Exercise Science
Minor: Nutrition
Biomechanics: Program of Study
Faculty Mentor: Chip Wade, Ph.D.

B. **Project Description:**

The Impact of the Menstrual Cycle Phases on Upper Extremity Injury Risk in Female Athletes

There has been a significant rise in the number of female athletes participating across the spectrum of sports. While there is a multitude of research studies looking at physiology in sports on performance, training methods and injuries; this research is general across genders. When it comes to female specific physiology in relation to training and injuries there is little research. One such gender specific physiological focus is the menstrual cycle in the female population. The literature suggests changes in joint laxity and muscle repair throughout the various phases of the menstrual cycle, which can affect how female athletes respond to training. To better understand how the fluctuating hormonal cycle affects sports performance, biomechanical changes, and injury risk, we must further investigate this topic to maximize sports performance, minimize injury and ensure proper care of female athletes.

The menstrual cycle varies for every female, but the typical cycle lasts for 28-35 days and consists of three main phases, all having different hormonal fluctuations. These fluctuations may have important implications for the female athlete. The first phase is the follicular phase, lasting from the first day of a typical 28-day cycle to the fourteenth day. The follicular phase is usually responsible for the variation in cycle duration. During the follicular phase, estrogen levels are expected to rise, until around the fourteenth day when a rise in luteinizing hormone and follicle-stimulating hormone trigger ovulation. The luteal phase lasts for 14-28 days after ovulation and is typically where we would see a rise in progesterone.

Previous research is limited and mainly focuses on lower extremity injuries, namely the anterior cruciate ligament. Changes in knee laxity have been seen during the preovulatory (luteal) phase but have also been said to be heightened during the ovulatory phase. Increased muscle or tendon-related injuries have been reported during the late follicular phase, as opposed to the early follicular or luteal phases. High levels of estrogen have been linked to decreased stiffness in ligaments and tendons, which can be a risk factor for injury because of instability issues. Understanding how hormonal fluctuations during the menstrual cycle affect biomechanical parameters could be highly beneficial, seeing that most of the current literature focuses solely on ankle and knee injuries, and remains inconclusive.

No studies have assessed the menstrual cycle's effect on upper extremity biomechanics in female overhead athletes. While shoulder injuries are more common in the male population, female athletes tend to experience higher rates of non-contact shoulder injuries in sports, such as volleyball, tennis, and softball, which can elicit high levels of stress on the glenohumeral joint. A better understanding of these biomechanics, such as laxity, range of motion, and strength, will help bridge the gap in the literature regarding the effects of the menstrual cycle on upper extremity injuries in female overhead athletes.

For this research, female overhead athletes will be recruited, and investigators will track their typical menstrual cycle over a season, using saliva tests to confirm the menstrual phase. A saliva test will be administered at each visit, allowing researchers to analyze hormone fluctuations and confirm the cycle phase before completing physical assessments. Athletes will visit the Human Movement and High-Performance lab and complete assessments for strength and mobility during each phase of their menstrual cycle. We will assess these performance measures using the Proteus, which is a resistance training machine that can provide constant resistance to any movement and provide a quantitative data set associated with each movement profile. There will be preset start and end positions for each movement that the athletes will complete. Making sure they stay within our calibrated parameters when completing these movements, the Proteus will provide us with detailed reports on their physical strength and power. We will use these reports to see the biomechanical changes in each athlete throughout their menstrual cycle.

This project will address the understudied topic of how the menstrual cycle affects certain biomechanical parameters in female athletes, specifically focusing on female overhead athletes. The results of this study will contribute to the need for more specific treatment, rehabilitation, strength training, and sports-specific programming for our female athletes based on their individual menstrual cycles. Furthermore, the study will have practical implications on the general population by providing a framework to study upper extremity injuries in the female workforce and the impact the menstrual cycle has on upper extremity work related musculoskeletal disorders (WMSD). These results will serve as a starting point for further research funding applications to the National Strength and Conditioning Association (NSCA), American College of Sports Medicine (ACSM) and the National Institutes for Occupational Safety and Health (NIOSH).

C. Impact Statement:

My future academic and professional aspirations are sports medicine and orthopedics. I plan to apply to Physical Therapy school following graduation and focus on athletic populations. Participating in research within the Human Movement and High-Performance Laboratory at the University of Mississippi will heavily impact my ability to navigate future research experiences and equip me with valuable knowledge in my field of interest, pertaining to performance in athletics. By engaging in undergraduate research, I will be able to foster my curiosity and develop skills that are not attainable outside of a lab. These skills, such as obtaining, evaluating, and presenting information, will better prepare me for graduate school and my desired career aspirations in physical therapy. Our research will shed light on the understudied topic of how the menstrual cycle affects performance in women's athletics, inherently affecting how women's training and sports are managed in the future. Furthermore, working in this lab will enhance my understanding of hormonal fluctuations due to the menstrual cycle and benefit my future career in physical therapy by allowing me to better understand my patients and individualize their treatment. Being awarded the STAMPS Impact prize would advance our research; thereby, advancing my educational opportunities and interests.

D. **Student and Faculty Mentor Roles.**

The faculty, research staff, and students that are affiliated with the Human Movement and High-Performance lab have regular meetings (Mondays or Tuesdays) each week to discuss active projects. Dr. Wade and his graduate student Kaitlyn Armstrong will serve as mentors to me during the project. Their responsibilities will be to monitor my work and oversee the daily data collection during the project. Additionally, Dr. Wade will provide scientific guidance on both the design and implementation of the study objectives as well as the presentation and writing of the final reports on the outcomes of the project. Mrs. Armstrong has been instrumental in describing and demonstrating the use of the laboratory equipment we will use during the project. With Dr. Wade's assistance, my responsibilities will be the writing and submission of the IRB for the project. I have completed the CITI training for research and have been active in working on the lab instrumentation. My responsibility will be to complete the research ethically and completely as described. Specifically, I will recruit the study participants prior to the start of the project. I will be the primary research member engaging the participants daily. I will collect the data, under the guidance of Dr. Wade and Mrs. Armstrong. Also, I will be responsible for analyzing the data and preparing a detailed final report and external presentation and potential manuscript on our findings.

E. Timeline and Product

The timeline for the project will be as follows:

1. Award November 15th, 2023
2. IRB submission November 25th, 2023
3. IRB Acceptance January 2024
4. Participant Recruitment Jan 15th- February 1st, 2024
5. February – May (2024) data collection
6. Summer, 2024 data analysis and final report preparation

Proposed work product:

1. Mid-South Biomechanics student abstract submission
2. Southeast ACSM student abstract submission
3. Manuscript submission (TBD)

F. Expense Budget

1. **Supplies: $3524.22**

Supply funds are requested in the amount of $215.13 to purchase four packs of ovulation testing strips (50 test strips per pack) to confirm ovulation. We are requesting $94.99 to purchase urine collection cups and lids. Funds in the amount of $52.14 are requested for the purchase of nitrile gloves for safe handling of the salivary analysis, urine samples and the ovulation testing. Additionally, we are requesting collection supplies to test for salivary estradiol samples. We are requesting funds in the amount of $3,309.09 to purchase the Salimetrics™ estradiol test kit. The funds will assist with the purchase of the following supplies: Saliva collection aids, Cryovials, Cryostorage boxes, Sample Cryo labels, and the Salivary 17β-Estradiol EIA kit.

2. **Animal Costs and/or Human Fees: $1350.00**

Human subject renumeration funds in the amount of $1350.00 are requested to provide participant compensation for the completion of the study. Each of the thirty participants will receive $50.00 for the time and effort allocated to the study.

3. **Total Project Costs: $4874.22**