

Title: The Female Athlete, Menstrual Cycle, and ACL Injury Risk: A Comprehensive Approach to Training and Education

Author: Scott Fava

Introduction

The role of gender in sports has evolved significantly over the years, with women increasingly participating and excelling in various athletic endeavours. However, the unique physiology of female athletes, particularly the menstrual cycle, has garnered increasing attention for its potential impact on injury risk and performance particularly anterior cruciate ligament (ACL) injuries which on average can lead to more than 12 months in rehabilitation. Understanding the interplay between the menstrual cycle and athletic performance is crucial for ensuring the holistic health and success of female athletes. This paper explores the relationship between the female athlete, her menstrual cycle, and the elevated risk of ACL injury. It also outlines essential steps to educate and supplement her training during this time, allowing for a more comprehensive and informed approach to female athlete health.

I. The Female Athlete and Her Menstrual Cycle

1.1 Menstrual Cycle Basics

The menstrual cycle is a complex, hormone-driven process that occurs in most women of reproductive age. It typically spans about 28 days and consists of four phases: the menstrual phase, the follicular phase, ovulation, and the luteal phase [1].

Menstrual Phase - Day 1 to 5
Follicular Phase - Day 1 to 13
Ovulation - Day 14
Luteal Phase - Day 15 to 28

These phases are regulated by fluctuations in hormone levels, primarily estrogen and progesterone. Understanding these phases of the menstrual cycle can help with the physiological impacts on athletic performance and injury risk.

1.2 The Impact on Athletic Performance

Research has shown that the menstrual cycle has no influence on various aspects of athletic performance in elite female athletes.

Strength and Power: [2] [3] [4]

Various methods to develop understanding in the difference in strength & power outcomes utilising 1RM testing for both upper & lower body exercises including Smith Machine Squat; Leg Press; Counter movement jump; Isometric grip strength found no significant differences between the phases and a decrease in strength & power.

Endurance: [4] [5] [6]

Various research to develop understanding in the anaerobic & aerobic endurance influence on the menstrual cycle have reached no significant difference in the menstrual cycles. Testing methods includes the anaerobic sprint test; 20s sprint cycle test; rowing to exhaustion and running on treadmills.

There are no significant changes to the ability of a female's athletic performance outcomes during any phases of the menstrual cycle. This allows within a team environment the opportunity for the Athletic Performance manager to continue to coach & develop female athletes regardless of the menstrual cycle.

II. Elevated ACL Risk of Injury

Females are 6 times at risk of injuring their anterior cruciate ligament as opposed to men [7]. In the context of professional sport, this equates to between 365 to 2190 days lost from a professional squad relating to ACL injury.

2.1 Menstrual Cycle and Ligament Laxity leading to ACL injury.

6 studies that separated the use of oral contraceptive found that female athletes were predisposed to injury during the pre-ovulatory phase or between Days 1-13 [7] [9]. One of the key mechanisms linking the menstrual cycle to injury risk in female athletes is the fluctuation in hormone levels. Another systematic review study found significant females with greater ACL laxity in the pre-ovulatory phase experience greater knee valgus and greater tibial external rotation during functional activity which led to increased risk of ACL injury.

However in a study by [8], they found a significant greater injury risk during the ovulatory phase, with over 70 female athletes with ACL injuries tested within 24 hours of their injury. During the luteal phase, when estrogen and progesterone are elevated, ligament laxity tends to increase. Ligament laxity refers to the looseness of connective tissues, such as ligaments, which can impair joint stability and increase the susceptibility to ACL injuries.

The latest systematic review study [10] reviewed over 1308 studies on comparing the menstrual cycle phase with ACL injury or anterior knee laxity. Over 2500 subjects were extracted and found there was no significant differences in the between the Follicular Phase to the Ovulatory Phase to the Luteal Phase in assessing ligament laxity, menstrual phase and ACL injury risk. It demonstrates that significant more research is required to enable better understanding of the hormonal changes and the phases limitations that occur for females athletes at risk of an ACL injury.

III. Steps to Educate and Supplement Training

Education plays a pivotal role in empowering female athletes to understand their bodies and make informed decisions about their training and competition schedule. Coaches, trainers, and medical professionals should provide comprehensive information on the menstrual cycle and its potential impact on athletic performance and injury risk. Key educational steps include:

3.1 Awareness: Athletes should be aware of their menstrual cycle and track it using apps or calendars. This knowledge helps them anticipate potential performance changes and adapt their training accordingly. Smartabase [11] is a leading app that helps data-driven military and sports organisations optimise human performance and reduce injury by enabling better decision-making. This app can also track the rest & recovery of an athlete to better provide awareness of stressors before training, with an increased in discomfort and fatigue, indicators of risk.

3.2 Consultation: Athletes should have access to knowledgeable healthcare providers who can address their questions and concerns regarding the menstrual cycle's impact on their sports performance and health.

3.3 Nutrition & Hydration: Educate athletes on how to optimise nutrition and hydration during different phases of the menstrual cycle, as nutritional needs may vary. The significant increase in loads through periodisation of programming can significantly alter appetite. If the athlete is not fuelling the body adequately this could lead to further increase in the joint laxity at certain menstrual phases which demonstrated can increase the risk of ACL injury.

Research [12] released last year discussed that ACL injuries focused on one event could be redefined as ACL traumas that are cumulative over a training program or campaign. These significant microtraumas to the ACL if understood could help to reduce the isolating event of the microtraumatic ACL rupture. The conclusion is that proper nutrition right through the menstrual phases was optimal in helping decrease the anterior knee laxity. Knee ligaments are 90% type I collagen, therefore supporting the recovery of the ligaments through microtraumatic events in training through a supplementation program and an enhanced nutritional program can decrease the incidence of a macro traumatic event. Such supplementation could include glycine-rich collagen peptides, Bovine hydrolysed collagen; gelatine-vitamin C and amino acids containing zinc & sulphur.

3.4 Monitoring and Adaptation

Regular monitoring and adaptation of training plans are crucial for female athletes. Coaches and medical professionals should collaborate with athletes to assess how they are responding to their training plans and make necessary adjustments. Athletes should also be encouraged to communicate openly about their experiences and any issues they encounter during different phases of the menstrual cycle.

Conclusion

The complex relationship between the female athlete, her menstrual cycle, and the associated risks of ACL injury is a multifaceted and evolving field of study. Understanding the basics of the menstrual cycle and its potential impact on athletic performance is essential for coaches, trainers, and healthcare professionals to provide holistic support to female athletes.

Research has shown that there is no significant impact of the menstrual cycle on various aspects of athletic performance in elite female athletes, the risk of ACL injury remains a significant concern. Studies have indicated that hormonal changes during the menstrual cycle can lead to increased ligament laxity, potentially predisposing female athletes to ACL injuries. However, conflicting findings and the lack of conclusive evidence emphasise the need for more extensive research to elucidate the specific hormonal changes and their relationship to ACL injury risk.

Nutritional strategies, including proper supplementation with collagen peptides and essential amino acids, emerge as potential avenues for reducing the risk of ACL injuries. Recognising the composition of knee ligaments and the importance of collagen in ligament health, such nutritional interventions may contribute to supporting ligament recovery and minimising the occurrence of a macrotraumatic event through increased support during microtraumatic ACL events.

Educational initiatives are critical in empowering female athletes to navigate their menstrual cycles effectively. Awareness, consultation with healthcare providers, and nutritional guidance are essential components of this educational process. Utilising technologies like Smartabase for menstrual cycle tracking and performance optimisation can contribute to more informed decision-making in training.

Further research, continuous monitoring, and collaborative efforts are crucial for advancing our knowledge and ensuring the well-being of female athletes in the dynamic landscape of elite sports.

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