Menstrual cycle phase and biomechanics in female footballers: a pilot study

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Introduction

- Females experience a greater incidence of ankle and knee ligament issues, sustaining anterior cruciate ligament (ACL)[1,2] injuries up to eight times as often as their male counterparts.
- Oestrogen and progesterone, key reproductive hormones in females, can affect musculoskeletal tissue such as muscle, tendon, and bone.[3] Existing research shows that hormonal cycles may challenge homeostasis and readiness to perform.[4]
- Poor biomechanics movements, such as knee valgus and pronated foot placement may increase the risk of sports-related injuries.[5] Efforts to explain mechanisms that link certain menstrual phases with increased injury risk are inconclusive and there is currently minimal research examining the biomechanics of movement patterns in relation to injury in female footballers.
- OpenCap, a new open-source software for cloud-computing movement dynamics from smartphone videos provides a low-cost, portable tool for scalable fieldwork biomechanics data collection.[6]

Aim

- To investigate how biomechanics movements change across the menstrual cycle
- To explore how biomechanics performance in the 1st week of data collection may differ from previous weight-based movement experiences in this poster

Methods

Study Participants

- *n* = 20 female football players from a single team in the 23-24 Football Women's National League Division One
- Inclusion criteria: over 18 years of age, and eumenorrheic (i.e. having had at least 10 periods in the past year)

Data Collection & Key Variables

- *Weight-based movement experience* (2 groups) and other baseline characteristics from online baseline player questionnaire
- Biomechanics computed with OpenCap (see Figure 1), with analysis focusing on single side (left/right) *mean peak* value and *imbalance* (difference of mean peaks) in hip adduction, hip flexion and knee angles from double-leg squats (DLS) and single-leg squats (SLS) and m*ean total LESS*[7] *errors* from jump-landing tasks

Figure 1. Left: Outdoors set-up at the football field during a data collection session in July; Right: Indoors set-up at the Institute of Sports Health and Exercise during testing OpenCap

- Players repeated testing battery for four times, weekly
- *Menstrual cycle* monitored by self-administered urinary hormone ovulation tests that tracks estrone-3-glucuronide (E3G) and luteinising hormones (LH) levels[8] and self-reported menses at baseline or through testing day questionnaires

Statistical Analysis

- All analyses performed with R in RStudio, alpha level = .05
- Descriptive demographics for baseline characteristics
- Kruskal–Wallis one-way ANOVA by ranks for the key variables across the two strength-based movement experience groups

Results & Discussion

There were no significant differences between the two groups but data showed the more experienced group with the trend of:
(1) higher individual (left and right side) values
(2) more consistent mean peak values
(3) fewer counts of LESS errors

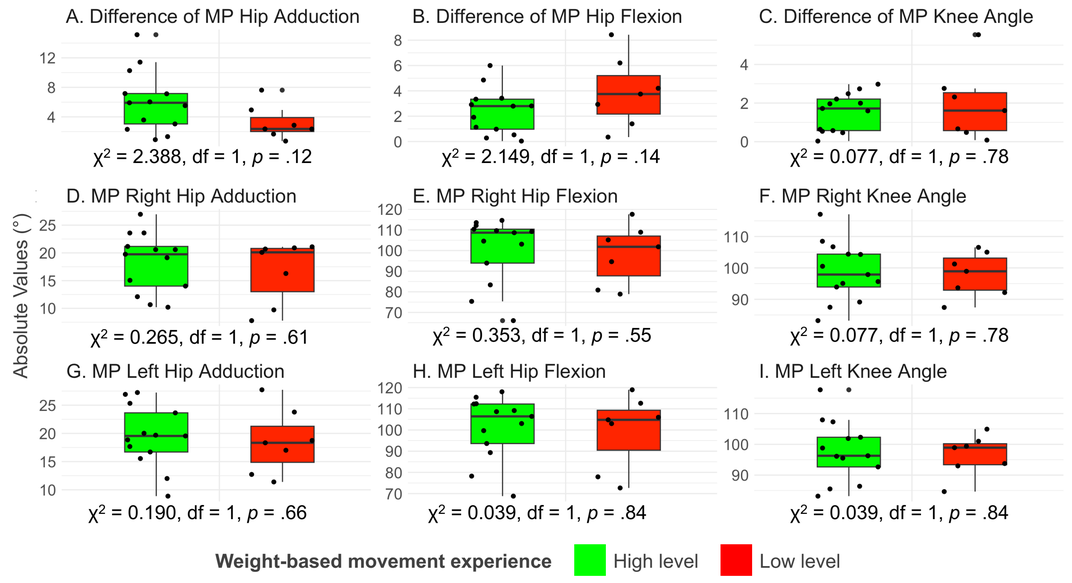

Figure 2. Biomechanics variables (Panels A to I) from DLS tests, stratified by weight-based movement experience (*n* = 20). Note: MP = Mean Peak

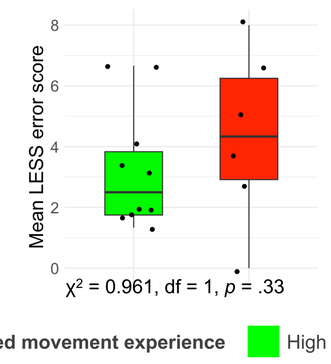

Figure 3. Individual averaged LESS error scores, stratified by weoght-based movement experience (*n* = 16).

Note: High level = those with "substantial experience (i.e. regular personal training)" and "fair bit of experience with a qualified personal trainer/coach"; low level = those with "some experience but only in a football team setting" and "some experience but on my own" in weight-based movements.

- Greater exposure to gym-related training, such as weight-based movements may contribute to better biomechanics performance through improvements in strength, balance and stability.[9]
- The focus of this poster is on the weight-based movement experience from the first week of testing, participants' menstrual phases were not considered in the analyses.
- A limited sample (*n* = 20 and *n* = 16 for hip/knee parameters and LESS analyses respectively) may be underpowered to detect small changes.

Conclusion & Future Plans

- Successfully piloted biomechanics data capturing with OpenCap for future scalable implementation with athletes in fieldwork settings
- Next steps include widening the list of biomechanics parameters considered, including up to 35 variables from OpenCap, kinematics within LESS's operational definitions and its binary errors[7]; and analysing data from the full range of menstrual cycle phases
- Ongoing plans to broaden the participating player base, expanding data collection to two more football teams for a larger sample size

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