Increased Lower Extremity Injury Risk Associated with Player Load and Distance in Collegiate Women’s Soccer

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- None
Introduction

- Over 13 million girls and women playing organized soccer worldwide.
- Increased performance expectations -> increased injury risk.
- Technological advances in player load tracking using wearable global positioning system (GPS) units may predict injury risk.
- Limited research regarding the impact of workload on injury risk specifically to women's soccer.
Purpose

- To examine the relationship between injury risk and workload collected from wearable GPS units in National Collegiate Athletic Association (NCAA) Division I women’s soccer players
Methods

- Retrospective analysis of prospectively collected GPS data from one NCAA Division I women’s soccer team
- 3 seasons (August - December 2017-2019); 65 individual soccer seasons included
- Workload quantified using commercially available GPS units (Catapult OptimEye, Catapult Sports, Melbourne, Australia)
Methods

- Variables collected: Player load (triaxial acceleration), total distance, high-speed distance (≥ 8 mph)
- All available players required to wear their GPS unit for training sessions and games. 95.3% compliance (7,654 of 8,032 sessions).
- Only time loss-injuries affecting the lower extremity included. Injuries were classified by body part, contact/non-contact, and by time missed: minimal (1-3 days missed), mild (4-7 days missed), moderate (1-4 weeks missed), or severe (4+ weeks missed).

Player load = \sqrt{\frac{(a_x(t) - a_x(t-1))^2 + (a_y(t) - a_y(t-1))^2 + (a_z(t) - a_z(t-1))^2}{100}}
Methods (Workload Analysis)

• Data categorized into weekly blocks from Monday to Sunday
• Previous 1-weekly, 2-weekly, 3-weekly, and 4-weekly cumulative loads calculated and grouped by z-score
• Acute to Chronic Workload Ratio (ACWR) calculated 2 ways
  – Rolling average: average acute workload (past 7 days) divided by average chronic workload (past 28 days)
  – Exponentially weighted moving average (EWMR): EWMA acute (N = 7 days) divided by EWMA chronic (N = 28 days)
Statistical Analysis

• Injury incidence, injury risks
• Logistic regression to compare ACWRs between injured and non-injured players for all GPS variables
• Each player injury matched by season and week to uninjured players for that week. Injured and uninjured cohorts were compared using two-sample $t$-tests.
Results

| Injury Location                          | Number |
|-----------------------------------------|--------|
| Knee                                    |        |
| ACL Tear                                | 2      |
| MCL Sprain                              | 6      |
| Other ligamentous, meniscal, or chondral injury | 4      |
| Foot and Ankle                          |        |
| Lateral Ankle Sprain                    | 8      |
| High Ankle Sprain                       | 1      |
| Ankle Fracture                          | 2      |
| Foot Ligament Sprain/Plantar Fasciitis  | 6      |
| Other Foot Injury                       | 2      |
| Thigh                                   |        |
| Hamstring Strain                        | 5      |
| Quadriceps Strain                       | 8      |
| Groin Strain                            | 2      |
| Contusion                               | 4      |
| Other hip, leg, or thigh injuries       | 3      |

Table 1: Number of injuries by location during the 2017, 2018, and 2019 seasons

| Daily ACWR Calculation Type | Load Variable | OR (95% CI)     | p-value |
|-----------------------------|---------------|-----------------|---------|
| 7:28 EWMA                   | PL            | 0.61 (0.12-2.92)| 0.54    |
|                             | TD            | 0.83 (0.18-3.85)| 0.81    |
|                             | HSD           | 1.24 (0.37-4.10)| 0.73    |
| 7:28 Simple Moving Average  | PL            | 0.53 (0.15-1.87)| 0.32    |
|                             | TD            | 0.58 (0.17-1.95)| 0.38    |
|                             | HSD           | 0.69 (0.26-1.87)| 0.47    |

Table 2. Odds of sustaining an injury for each one-unit change of ACWR calculated using an EWMA model or simple moving average model. ACWR-Acute to chronic work ratio; OR-Odds ratio; CI-Confidence interval; EWMA-Exponentially weighted moving average; PL-Player load; TD-Total Distance; HSD-High Speed Distance.
Results

Figure 1. Comparison between healthy and injured players for 1, 2, 3, and 4-weekly accumulated (A) player load, (B) total distance, and (C) high speed distance. *P<0.05.
Discussion

- Incidence of lower extremity injury over 3x higher in games compared to practices (11.25/1,000 game hours vs. 3.07/1,000 practice hours).

Use of absolute load vs. ACWR:

- High accumulated total distance over four weeks associated with increase in injury risk for male youth soccer players
  - Bowen et al. BJSM 2017

- Increased ACWR -> increased injury risk in youth and professional men’s soccer. Our study showed no association, but when ACWR is between 0.8-1.3, injury risk is lower.
  - Bowen et al. BJSM 2017, 2020
  - Blanch and Gabbett. BJSM 2016
Limitations

- Both contact and noncontact injuries included
- Majority of injuries occurred during games – substitute players may have lower loads and injury risk
- Only external load tracked
- Data from one team – could not calculate position-specific risks
Conclusions

- Higher accumulated player load and total distance, but not ACWR, are associated with injury in women’s soccer players.
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Thank You