Integrative Assessment and Prediction Modeling for Injury Risk Mitigation in Division 1 Female Soccer Athletes: A Comprehensive Approach Utilizing Wearable Technology

JOSEPH AMITRANO, JUQI LIN, LAUREN CALABRESE, GINA LEWANDOWSKI

Seshadri Lab; Bioengineering; Lehigh University; Bethlehem, PA

Category: Doctoral

Advisor / Mentor: Seshadri, Dhruv (dhs223@lehigh.edu)

ABSTRACT

There is a pressing need for effective injury prevention methods to mitigate time-loss injuries. This study aims to develop a predictive recovery model for Division 1 female soccer athletes by integrating physiological, biomechanical, and subjective wellbeing assessments. **PURPOSE** The growing popularity of women's sports, particularly soccer, has brought the critical issue of injury risk management. While existing literature underscores the importance of maintaining an optimal acute to chronic workload ratio (ACWR) to mitigate injury risks, there remains a gap in understanding additional predictive metrics for athlete health. This deficit is pronounced in the context of women's soccer, where research focusing on injury prevention strategies is scarce. **METHODS** Ethical clearance was obtained per Institutional Review Board under protocol 2113291-3. Training data from a cohort of 20 female Division 1 soccer athletes over one month, encompassing physiological (heart rate, training impulse (TRIMP), and recovery), biomechanical (total distance covered, distance covered based on percentages of top speed, accelerations, and decelerations), and subjective (rate of perceived exertion, stress, and soreness) metrics were collected. Correlation analysis was conducted to explore relationships between the various metrics and recovery score highlighted by a wearable device. Robust Machine Learning models, encompassing Random Forest was utilized to explore the predictive capabilities of significant metrics for predictive recovery. **RESULTS** A Random Forest prediction analysis was performed, revealing that TRIMP and distance exhibited highest importance with a value of 8727.121 and 5850.881 respectively. From the model, a graph of predicted recovery against actual recovery was created with an r-squared value of 0.912. **CONCLUSIONS** By integrating various metrics, including physiological, biomechanical, and subjective data, we gathered important metrics outlining athletes' performance. Our findings highlight the significance of TRIMP and total distance in predicting athletes' wellbeing and offer a framework for forecasting recovery. These insights can guide targeted interventions and informed coaching decisions to enhance athlete health and performance.