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Predicting Ankle Injury Severity in High School Football Players: A Machine Learning Approach

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No financial disclosures

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Financial Disclosures

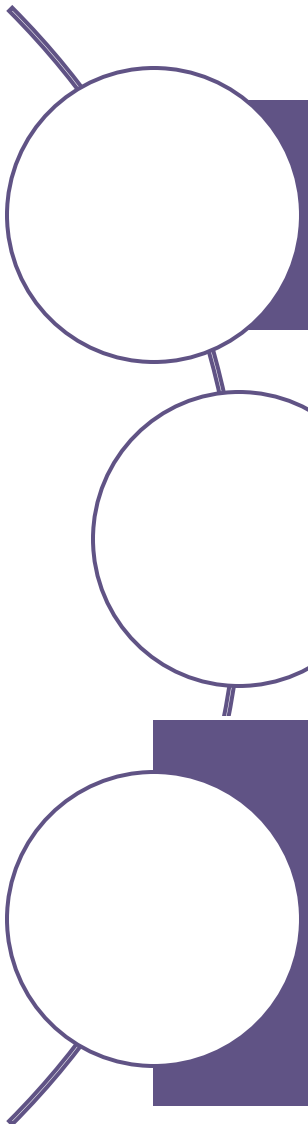- No Financial Disclosures

Background

- Injuries in high school football can predispose both **physical** and **emotional** sequalae [1-2]

- Injuries can lead to time loss from sports participation, long-term functional impairments, and increased risk of recurrent injuries

- **Sport-specific guidelines** must continue to evolve to protect athletes from these injuries.

  - **Machine learning (ML)** presents a largely untapped frontier for improving patient outcomes

Objective

To use ML modeling to effectively prognosticate ankle injury severity in high school football based on patient, sport, and setting-specific factors

Methods

Database: High School Reporting Information Online (RIO) 2005-2019

Primary Outcome: Prolonged Return to Sport (RTS) (≥22 days)

Balanced random forest (RF)

Logistic regression (LR)

Support Vector Classifier (SVC)

XGBoost

Results

Injury Demographics

- **A total of** 4,999 ankle injuries were included

- The average age was 16.05 years (SD = 2.01), height was 69.8 inches (SD = 3.5), and weight was 184.2 pounds (SD = 39.2)

- **Year in school** was categorized as freshman (17.6%), sophomore (22.1%), junior (26.3%), and senior (32.6%).

- Most injuries were ultimately **ligament sprains** (66.2%) or **incomplete tears** (21.7%)
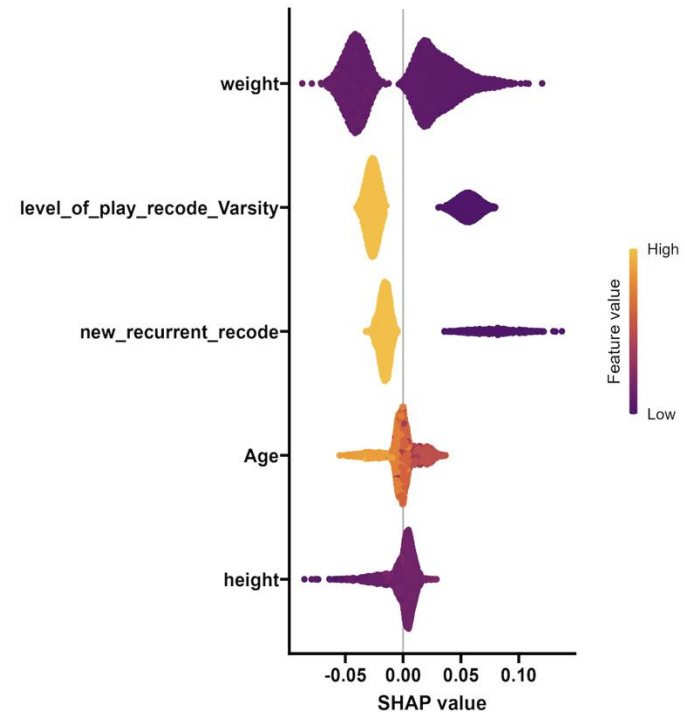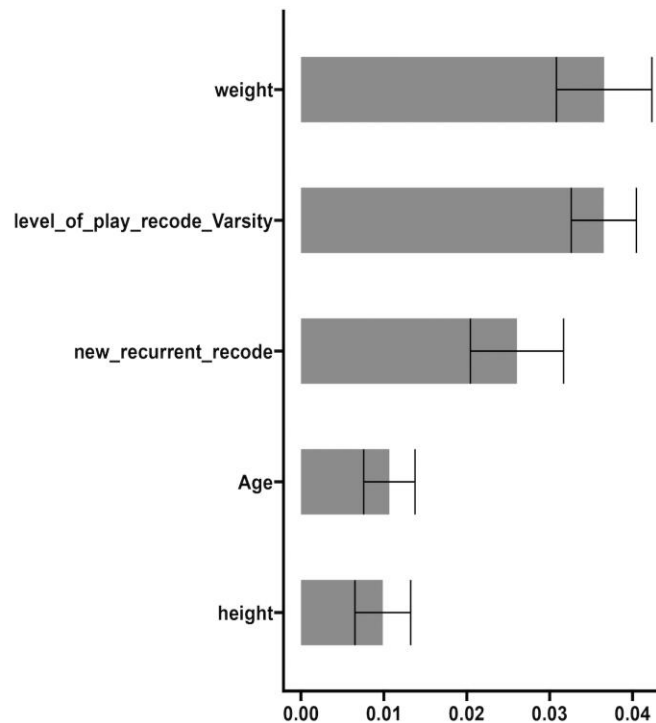
Results

Performance of Machine Learning Models

The <u>Random Forest</u> had the best performance, followed by XGBoost.
All models performed very well.

Outcome	XGBoost AUC (95% CI)	LR AUC (95% CI)	Random Forest AUC (95% CI)	SVC AUC (95% CI)
Prolonged RTS (n = 677)	0.850 (0.8251 - 0.8628)	0.827 (0.800 - 0.844)	**0.852 (0.836 - 0.865)**	0.808 (0.794 - 0.820)

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Results

Feature Importance Analysis of GBM

Advanced <u>level of play</u>, heavier <u>weight</u>, and <u>recurrent injury status</u> were the top three injury predictors.

Results
Feature Importance

- Feature importance analysis was conducted on RF and found the most influential variables to be increased ligament tear severity (coefficient: 2.813) and assessment method of x-ray (coefficient: 2.109)

- Other important features included weight of the athlete [coefficient: 1.669], and assessment method of surgery (coefficient: 1.64)

- Regarding football specific features, stepping on a teammate's foot (coefficient: 0.9358) and playing in punt coverage (coefficient: 0.8904) had the highest influence in predicting severity of ankle injury.

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Conclusion

1. In this study, we successfully leveraged machine learning to build and optimize models capable of accurately and reliably predicting severity of ankle injuries sustained by high school athletes playing American Football.

2. In addition, we performed a feature importance analysis to identify the strongest predictors of injury severity

References

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