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Risk Stratification of Shoulder Injury Severity in High School Football Players Using Machine Learning Techniques

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No financial disclosures

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Financial Disclosure Statement

- No Financial Disclosures

Background

- Severe injuries in high school sports have both **physical and emotional** ramifications.[1-3]

- **Sport-specific guidelines** must continue to evolve to protect athletes from these injuries.
  - Growing role of **machine learning (ML)**[4]

Methods

High School Reporting Information Online (RIO) queried for boys' football injuries from 2005-2019.

Return to Sport (RTS) and predictor variables selected.

ML models tested and feature importance analysis performed.[5]

- Balanced random forest (RF)
- Elastic-net regression (ENet)
- Gradient boosted tree (GBM)
- Neural net (NN)

Results

Injury Demographics

- **A total of 2,405 injuries** were studied (mean age = 16.1 ± 1.2 years).

- **Level of play** was categorized as freshman (8.6%), junior varsity (21.5%), **varsity (66.1%)**, and other (3.8%).

- **Time of season** was categorized by preseason (24.8%), **in-season (70.6%)**, postseason (4.5%), and other (0.8%).

- 355 injuries (14.8%) experienced a **prolonged return to sport (RTS)**.
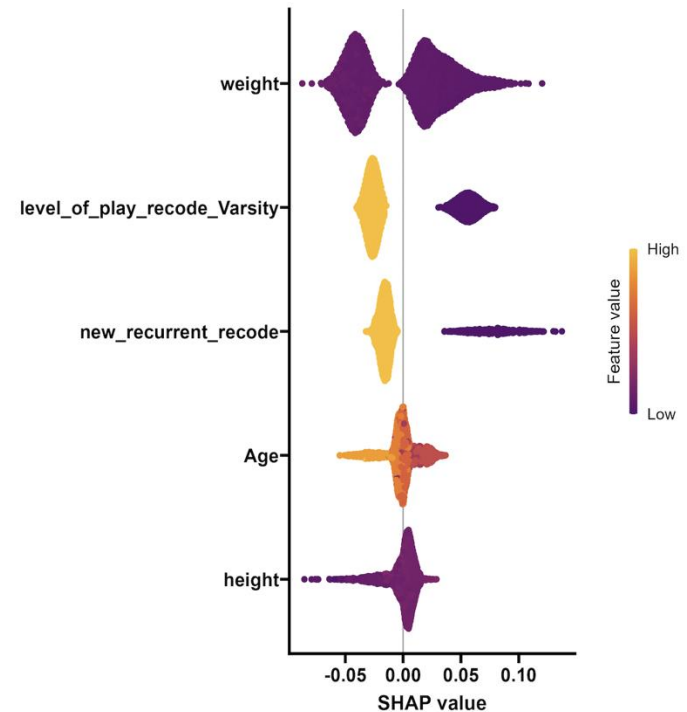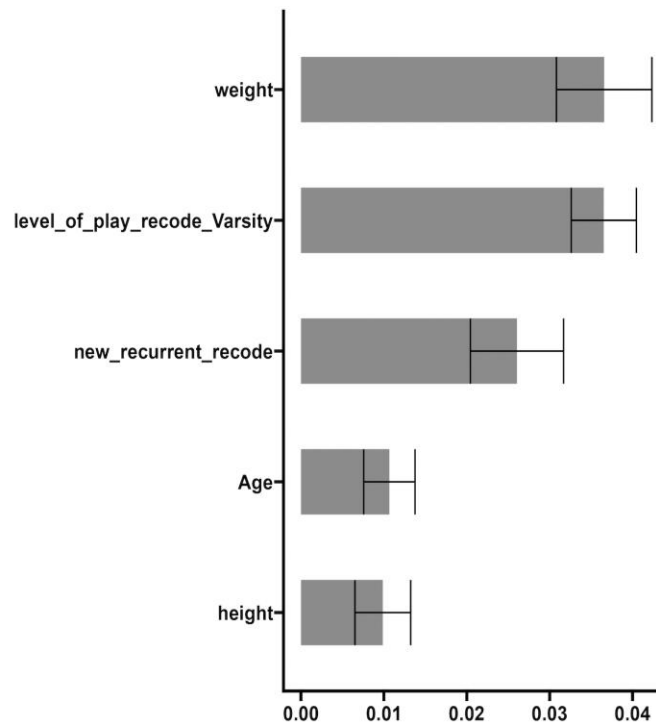
Results

Performance of Machine Learning Models

The <u>Gradient Boosted Tree (GBM)</u> had the best performance, marginally outperforming the other models.

Outcome	Benchmark AUC (± 95% CI)	Gradient Boosted Tree AUC (± 95% CI)	Elastic Net AUC (± 95% CI)	Random Forest AUC (± 95% CI)	Neural Network AUC (± 95% CI)
Prolonged Return to Sport (n = 355)	0.5 ± 0.00	**0.61 ± 0.01** ★	0.60 ± 0.01	0.60 ± 0.02	0.57 ± 0.02

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.

Conclusion

1. Given the results of the feature importance analysis, we suggest that injury prevention efforts focus on high school football players with **recurrent injuries** and those of **higher weights** and **levels of play**.

2. This study suggests the **utility of machine learning models** to help generate guidelines for athlete injury prevention.

References

1. Hoge C, Sabbagh R, Morgan M, Grawe BM. Epidemiology of youth and high school American football-related injuries presenting to United States emergency departments: 2010-2019. Phys Sportsmed. 2022 Aug;50(4):332-337. doi: 10.1080/00913847.2021.1931980. Epub 2021 May 31. PMID: 34029497.
2. Wolanin A, Gross M, Hong E. Depression in athletes: prevalence and risk factors. Curr Sports Med Rep. 2015 Jan;14(1):56-60. doi: 10.1249/JSR.0000000000000123. PMID: 25574886.
3. Xanthopoulos MS, Benton T, Lewis J, Case JA, Master CL. Mental Health in the Young Athlete. Curr Psychiatry Rep. 2020 Sep 21;22(11):63. doi: 10.1007/s11920-020-01185-w. Erratum in: Curr Psychiatry Rep. 2020 Oct 2;22(12):64. doi: 10.1007/s11920-020-01190-z. PMID: 32954448.
4. Van Eetvelde H, Mendonça LD, Ley C, Seil R, Tischer T. Machine learning methods in sport injury prediction and prevention: a systematic review. J Exp Orthop. 2021 Apr 14;8(1):27. doi: 10.1186/s40634-021-00346-x. PMID: 33855647; PMCID: PMC8046881.
5. Amendolara A, Pfister D, Settelmayer M, Shah M, Wu V, Donnelly S, Johnston B, Peterson R, Sant D, Kriak J, Bills K. An Overview of Machine Learning Applications in Sports Injury Prediction. Cureus. 2023 Sep 28;15(9):e46170. doi: 10.7759/cureus.46170. PMID: 37905265; PMCID: PMC10613321.

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