Integration of Subjective and Objective Assessment Tools to Optimize Health and Performance in Division 1 Collegiate Female Soccer Athletes

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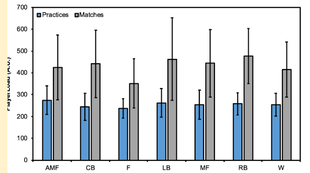
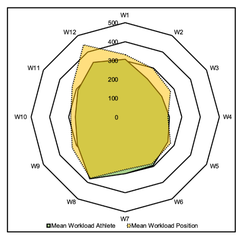
INTRODUCTION

- Need to reduce injury in training and competitions from a coaching perspective.
- Leveraging wearable technologies to access athletes' well-being.
- Lack of objective data in female soccer despite high injury rates

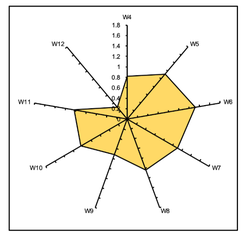
"I want to know how my athletes are performing during practices and matches and relative to each other. I have data but don't know what to do with it and need a way to analyze the data quickly to inform training. I am seeing spikes in injury and need a way to stop this". –Head Coach



***~1.8x difference** in workload b/w practice and matches necessitated changes in protocols to meet demands of the matches*



Mean WL: athlete vs position group



ACWR for athlete chronic WL 3 weeks

Figure 1: Need for quantitate measure for athlete performance and health

OBJECTIVE

- Validate critical physiological, subjective, and objective parameters from athletes.
- Develop predictive machine learning models to mitigate injury burden and enhance coaching decisions. 9
- Translate analytics from a reactive to proactive means (e.g. quantify recovery)

Internal	Heart rate	Heart rate Variability
External	Distance	Workload
Subjective	Soreness	Rate of Perceived Exertion (RPE)

Figure 2: Wearable devices used to collect internal, external, and subjective metrics collected from Division 1 female soccer athletes to give a wholistic view of the athlete

MATERIALS AND METHODS

- Data was collected utilizing cutting-edge wearable devices and questionnaires to gather wholistic metrics on athlete wellbeing.
- Data analysis were conducted using R-studio (R-studio, PBC).
- First IRB approved study between engineering and athletics (IRB# 2113291-3)

RESULTS AND DISCUSSION

- Metrics from the WHOOP and Beyond Pulse wearable sensors were used to develop physiological models to assess load-response relationships
- Correlation statistics were used to discover specific relationships between variables.
- Utilized relationships to develop a predictive machine learning model using Random Forrest to ascertain a prediction of an outcome measure (recovery) with an r^2=0.911.

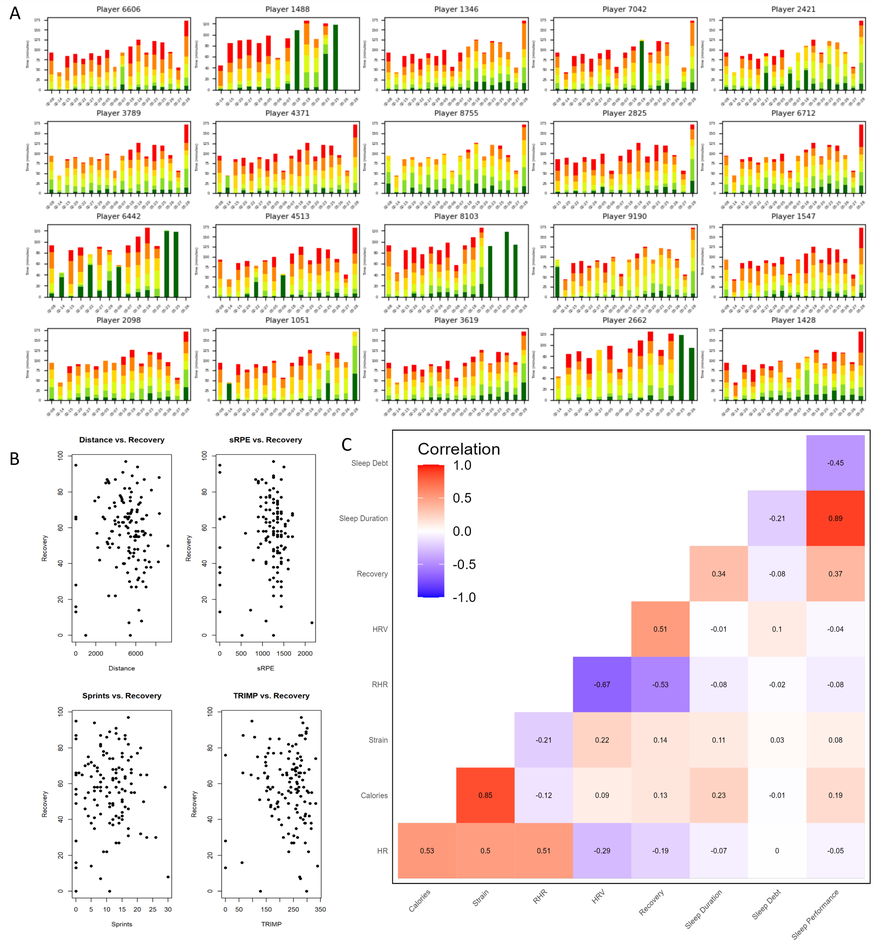


Figure 3: Graphical Depictions of metrics. A: Heart rate over time for athletes. B: Relationship to recovery. C: Correlation plot to gather strength of relationships

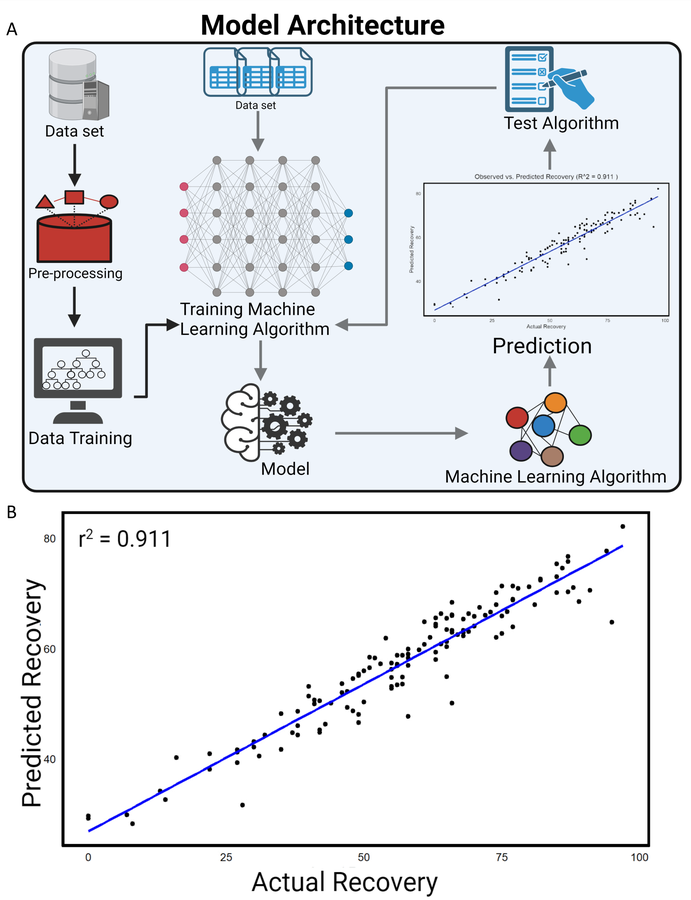


Figure 4: Process flow of developing and execution of the machine learning model. A: general workflow of the process. B: Prediction output of the model versus the actual output

CONCLUSIONS, FUTURE WORK, AND ACKNOWLEDGEMENTS

- From the metrics, we developed a machine learning model to predict an outcome measure (recovery) with an r^2 = 0.911.
- Future work will dive into development of more robust models that can accurately predict more than one outcome measure (fatigue, soreness, recovery).
- Inclusion of more metrics to develop an athlete readiness score that is a holistic approach to athlete well-being.
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