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# Injury Prediction Model For Lower Limb Sports Injuries - A Novel Machine Learning Based Approach:

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# Faculty Disclosure Information

- No relevant disclosure



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23 million annually

\$265 million/state

Prevention is better than a cure

> [J Epidemiol Glob Health](#). 2018 Dec;8(3-4):171-175. doi: 10.2991/j.jegh.2017.10.010.

## **An Estimation of the Burden of Sports Injuries among African Adolescents**

> [J Sci Med Sport](#). 2019 Feb;22(2):175-180. doi: 10.1016/j.jsams.2018.07.010. Epub 2018 Aug 4.

**Incidence, costs, and temporal trends of sports injury-related hospitalisations in Australian children over a 10-year period: A nationwide population-based cohort study**

# Problems in prevention:

Multifactorial nature  
of sports injuries

class imbalance  
problems

Negative or injury class is  
much less when compared to  
the non-injured population.

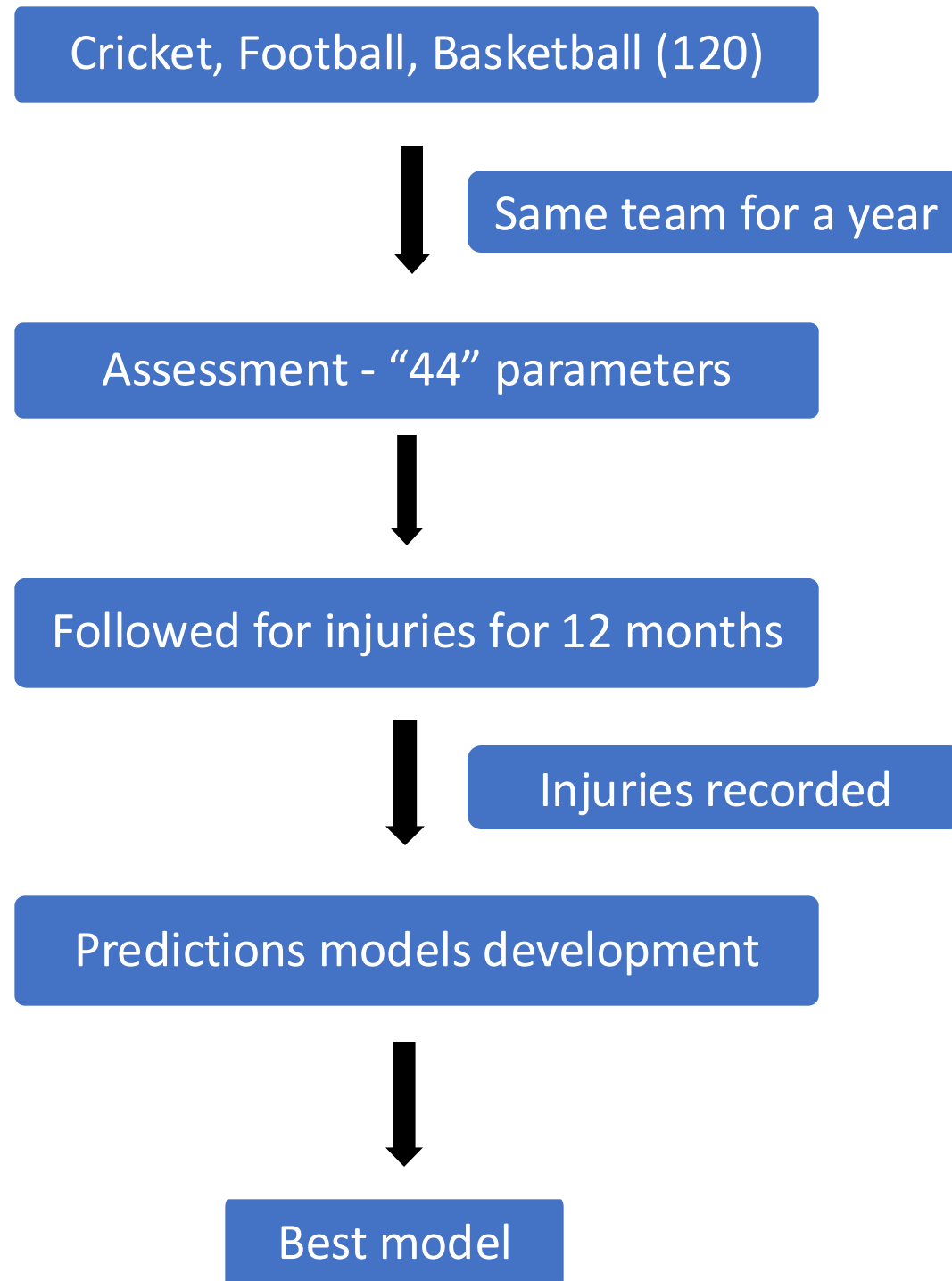
Available screening tests –  
three to four risk factors

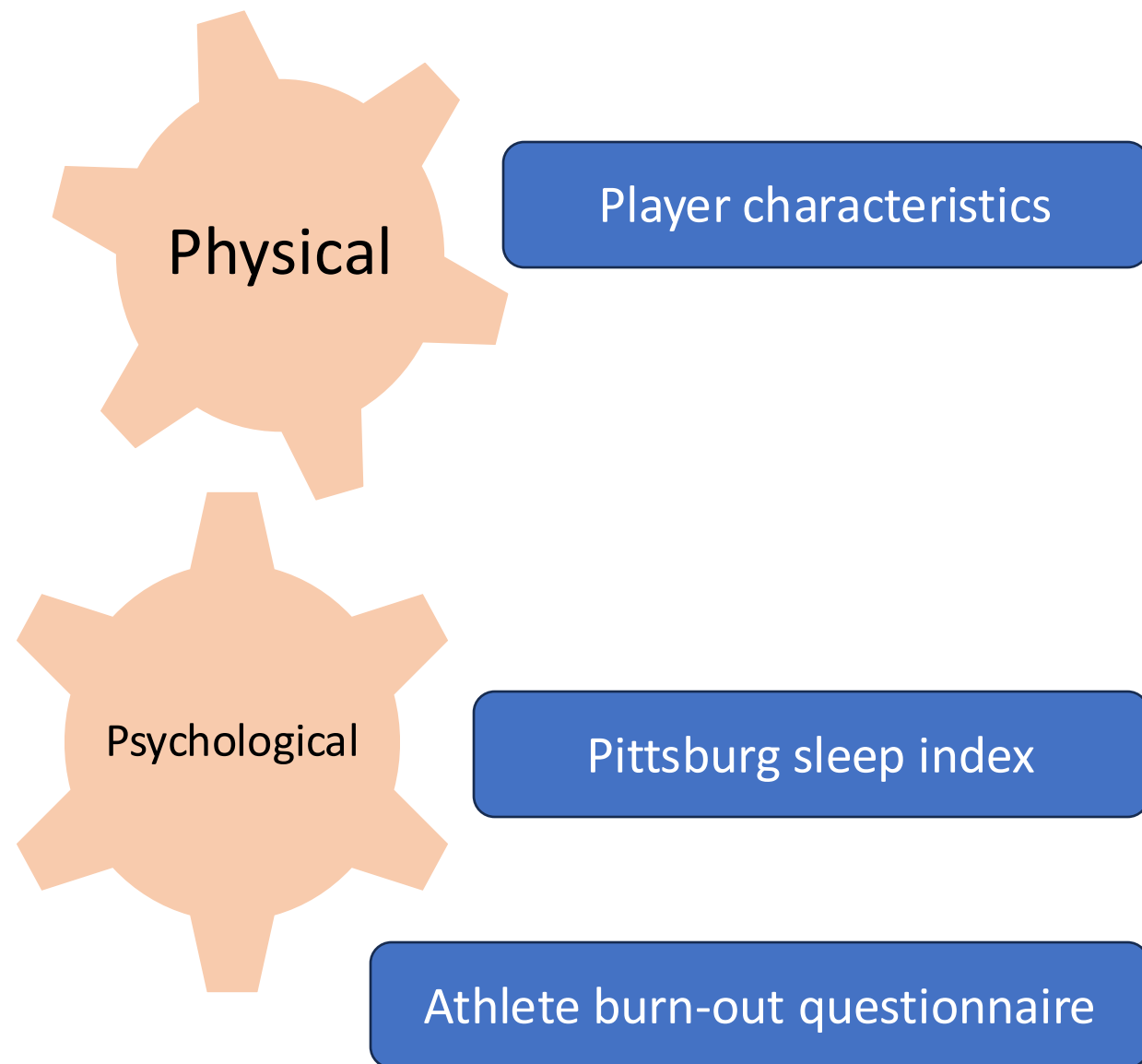
> Scand J Med Sci Sports. 2022 Nov;32(11):1625-1638. doi: 10.1111/sms.14199. Epub 2022 Jun 3.

**Players with high physical fitness are at greater risk  
of injury in youth football**

Mari Leppänen <sup>1 2</sup>, Aliisa Uotila <sup>1</sup>, Kari Tokola <sup>3</sup>, Hannele Forsman-Lampinen <sup>4</sup>, Urho M Kujala <sup>5</sup>,

# Study Process





#### Annexure 1: Personal risk factors assessment:

1. Sport involved
2. Playing position
3. Current level of play – University level/State level/National level/International level
4. Dominant leg
5. Age
6. Height, weight, and BMI
7. Playing turf – cement, mat, clay, mud, grass
8. Predominant environment of play – indoor/outdoor/both
9. Number of injuries in the last 12 months  
(Injury is defined as an acute pain in the muscle location that occurred during training or competition and resulted in the immediate termination of play and inability to participate in the next training session or match)

> [J Sci Med Sport](#). 2006 May;9(1-2):125-34. doi: 10.1016/j.jsams.2006.03.017. Epub 2006 Apr 19.

#### **Changes in athlete burnout over a thirty-week "rugby year"**

S L Cresswell <sup>1</sup>, R C Eklund

> [J Sport Exerc Psychol](#). 2001 Dec;23(4):281-306. doi: 10.1123/jsep.23.4.281.

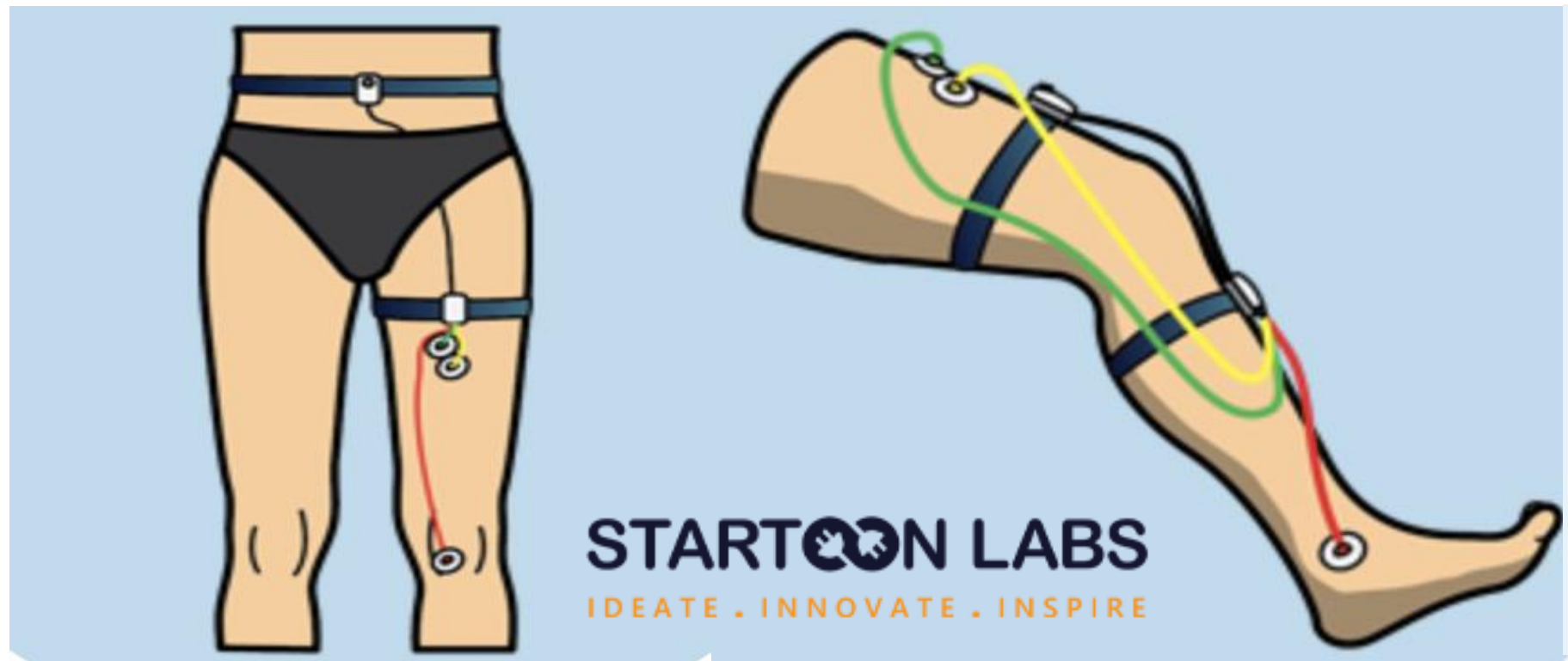
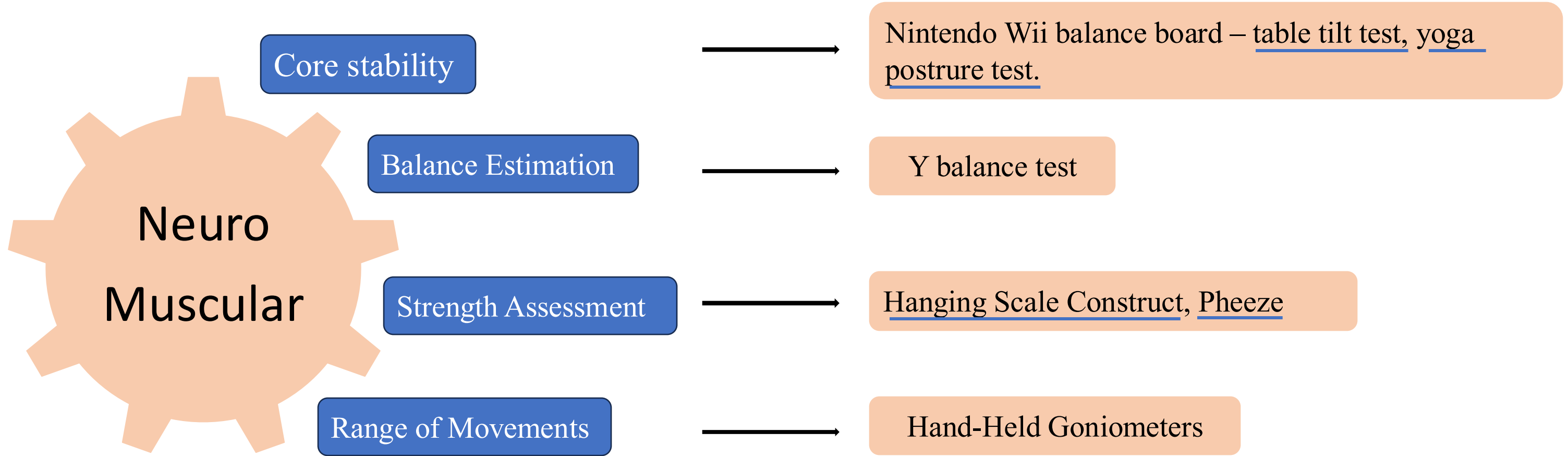
#### **Development and Preliminary Validation of an Athlete Burnout Measure**

Thomas D Raedeke <sup>1</sup>, Alan L Smith <sup>2</sup>

> [Psychiatry Res](#). 1989 May;28(2):193-213. doi: 10.1016/0165-1781(89)90047-4.

#### **The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research**

D J Buysse <sup>1</sup>, C F Reynolds 3rd, T H Monk, S R Berman, D J Kupfer

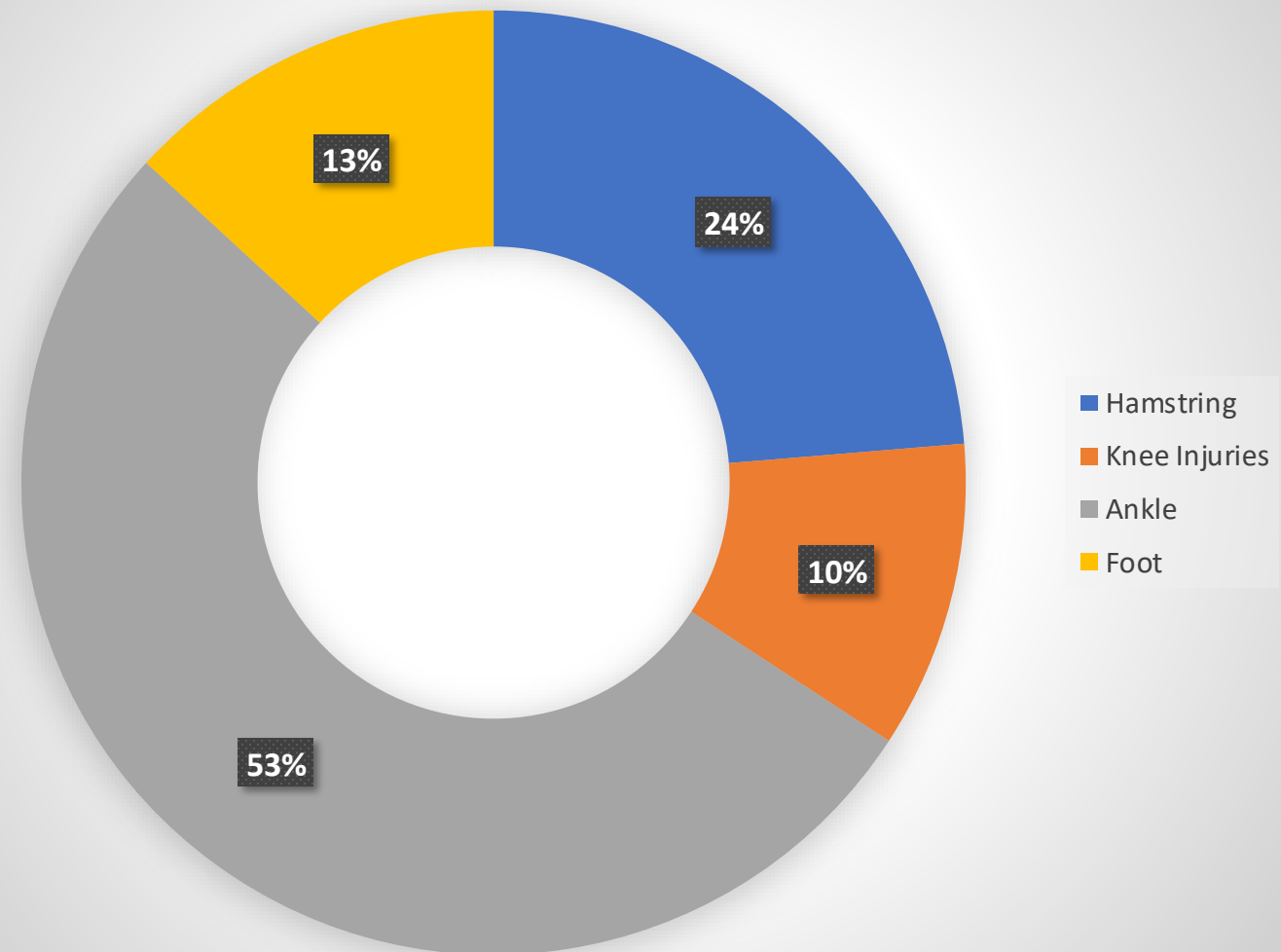


# Feature Creation

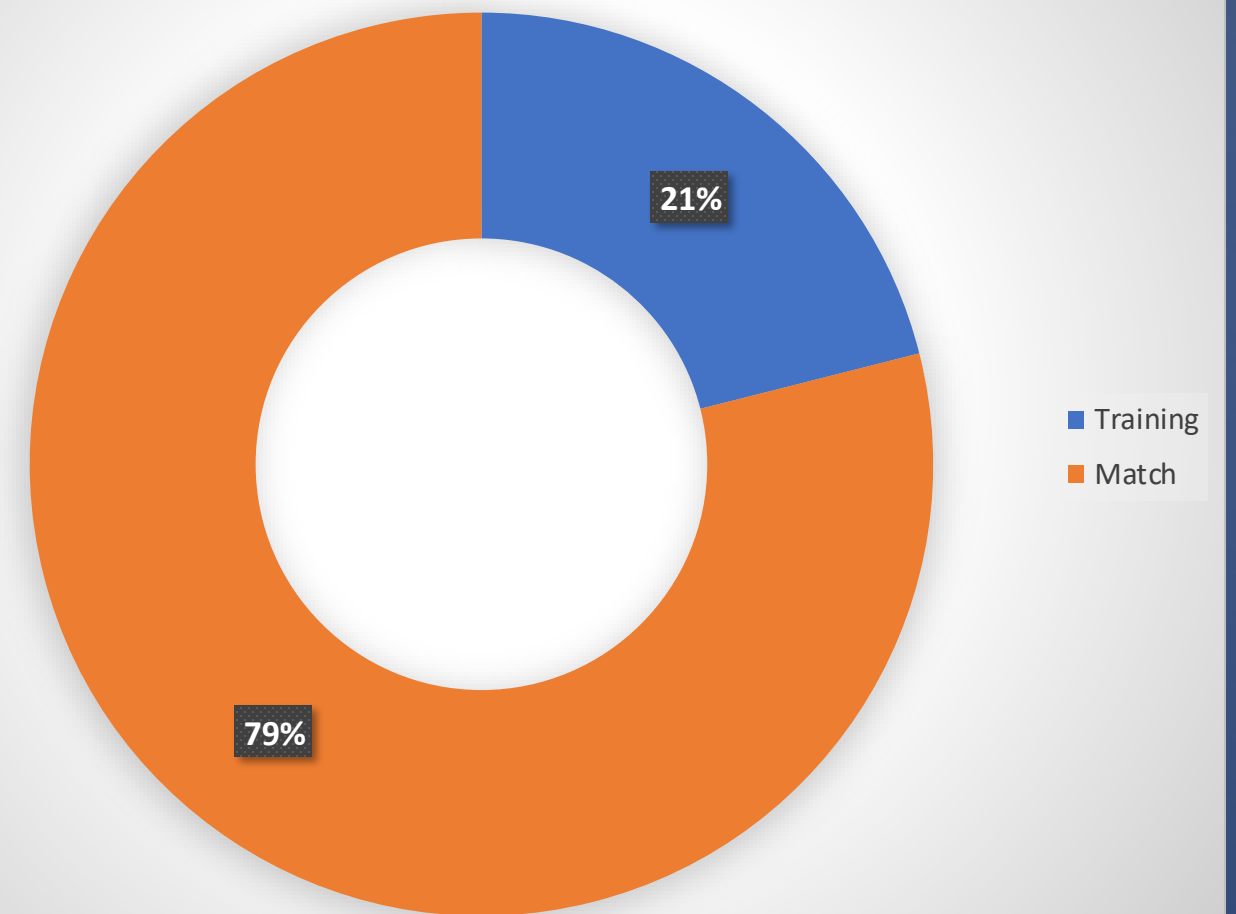
Knee	Knee Flexion/Extension strength Ratio
Hip	Hip Abduction/Adduction Ratio
Asymmetry	Side to side asymmetry <ul style="list-style-type: none"><li>• &gt;10 percent difference</li></ul>



## Total Injuries - 38



## Scenario



### Machine learning models used and their results

Algorithm	Description	Results
Logistic Regression	Logistic regression estimates the probability of an event occurring, such as voted or not voted, based on a given dataset of independent variables. Since the outcome is a probability, the dependent variable is bounded between 0 and 1	Accuracy: 0.4 AUC:0.6666666666 FPR = 0.8333333 TPR = 0.75 TNR = 0.1666666
Naive Bayes	The Naive Bayes is a classification algorithm that is suitable for binary and multiclass classification. Naïve Bayes performs well in cases of categorical input variables compared to numerical variables.	Accuracy: 0.5 AUC:0.625 FPR = 0.333333 TPR = 0.5 TNR = 0.66666666
AdaBoost Classifier	An AdaBoost classifier is a meta-estimator that begins by fitting a classifier on the original dataset and then fits additional copies of the classifier on the same dataset.	Accuracy: 0.5 AUC:0.625 FPR = 0.5 TPR = 0.5 TNR = 0.5
Random Forest Regressor	A random forest is a meta estimator that fits a number of classifying decision trees on various sub-samples of the dataset and uses	Accuracy: 0.6 AUC:0.666 FPR = 0.333333 TPR = 0.5 TNR = 0.6666666
Decision Tree Classifier	A decision tree is a non-parametric supervised learning algorithm, which is utilized for both classification and regression tasks. It has a hierarchical, tree structure, which consists of a root node, branches, internal nodes and leaf nodes	FPR = 0.333333 TPR = 0.75 TNR = 0.66666 Accuracy: 0.7 AUC:0.708333333

# Best Model?

## **K Nearest Neighbour algorithm (KNN)**

- Accuracy = 0.82
- Area under ROC = 0.87,
- True positive rate = 97%,
- True negative rate = 62.5%



# Key factors for injury

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Three components of the athlete burnout questionnaire i.e., **emotional/physical exhaustion, devaluation and a reduced sense of accomplishment,**

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Hip flexion Strength,

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Knee Flexion Strength

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Ankle Dorsiflexion



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