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Staidéar Fadaimseartha na hÉireann um Dhul in Aois
The Irish Longitudinal Study on Ageing

Applying Machine Learning to Differentiate Predictors of Syncope, Simple and Complex Falls in The Irish Longitudinal Study on Ageing (TILDA)

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Introduction

The use of machine learning in the medical field has been rapidly scaling in recent years, due to its ability to handle big datasets and its automated learning capability to give better predictions.

Random Forest is a tree-based machine learning algorithm that utilizes ensemble learning to generate predictions and analyses in classification problems.

Falls in older adults are clinically heterogenous, and can be classified as simple (accidental), complex (recurrent, unexplained, injurious) and due to syncope.

Identification of relevant modifiable risk factors with the use of machine learning methods could aid efforts in falls management, reducing its disproportionate morbidity and mortality.

Aims

To generate individual machine learning models for simple, complex and syncopal falls with the TILDA dataset using the Syncope-Falls Index (SYFI), a 40-deficit index covering an extensive range of risk factors.[1]

Methods

New self-reported events of simple, complex falls, and syncope were recorded in participants two-yearly between TILDA Wave 1 (2010) and 4 (2016).

Age, gender, fear of falling, fall in last year, history of blackout/ faint, and frequent fainter when young were extracted from the TILDA dataset and along with the existing features from the SYFI index were entered into three separate random forest models to derive feature importances.

Within each model, 30% of its dataset was used as the test dataset.

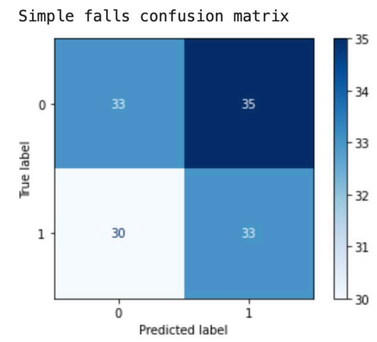
To avoid biased analysis due to the skewed class distribution, the dataset for each model was balanced by equalising the number of participants who did and did not have each event.

Results

The top 5 predictors of Simple, Complex and Syncopal falls are reported as below, along with the confusion matrix of each respective test dataset:

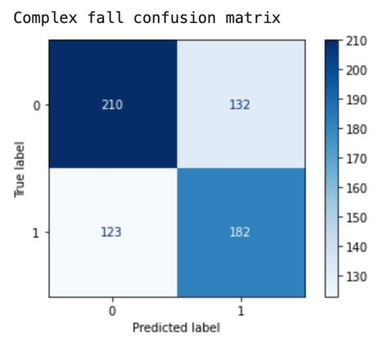
Simple falls (217 events, balanced dataset N=434, Test dataset n= 137)

Predictors	Feature importance
Age	0.16
Fear of falling	0.05
Fall in last year	0.04
Hypertension	0.04
Gender	0.04



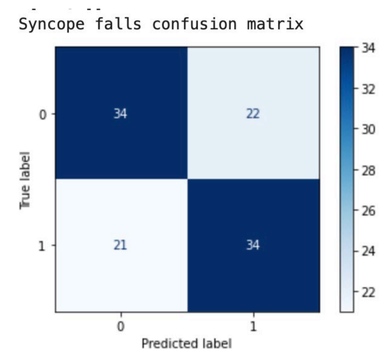
Complex falls (1077 events, balanced dataset N=2054, Test dataset n= 647)

Predictors	Feature importance
Fall in last year	0.18
Fear of falling	0.08
Osteoporosis	0.08
Gender	0.05
Osteoarthritis	0.05



Syncopal falls (185 events, balanced dataset N=370, test dataset =111)

Predictors	Feature importance
Age	0.21
Fall in last year	0.07
Polypharmacy	0.05
Frequent fainter when young	0.04
Antihypertensives	0.04



Conclusion

A previous fall event was consistently a top predictor in all types of falls, highlighting the importance of falls prevention in management.

Many predictors identified as relevant are modifiable, and this may help prioritize intervention for maximum population benefit.

The prevalence of medication predictors within the syncope model underscores the current emphasis of medication review within management of syncope.

The moderate accuracy of the Random Forest models underscores the known difficulty in predicting falls even when attempting to break their clinical heterogeneity.

References: Fitzpatrick, N, and R Romero-Ortuno. 2021. "The Syncope-Falls Index: A Tool For Predicting Risk Of Syncope And Complex Falls In The Older Adult Based On Cumulative Health Deficits". *QJM: An International Journal Of Medicine*. doi:10.1093/qjmed/hcab141.
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