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## Machine learning versus classic electrocardiographic criteria for left ventricular hypertrophy in a young pre-participation cohort: results from the SAFE protocol study

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**Background/Introduction:** Classic electrocardiographic (ECG) criteria for left ventricular hypertrophy (LVH) have been well studied in Western populations, particularly in hypertensive patients. However, their utility in Asian populations is not well studied, and their applicability to young pre-participation cohorts is unclear. We sought to evaluate the performance of classical criteria against that of machine learning models.

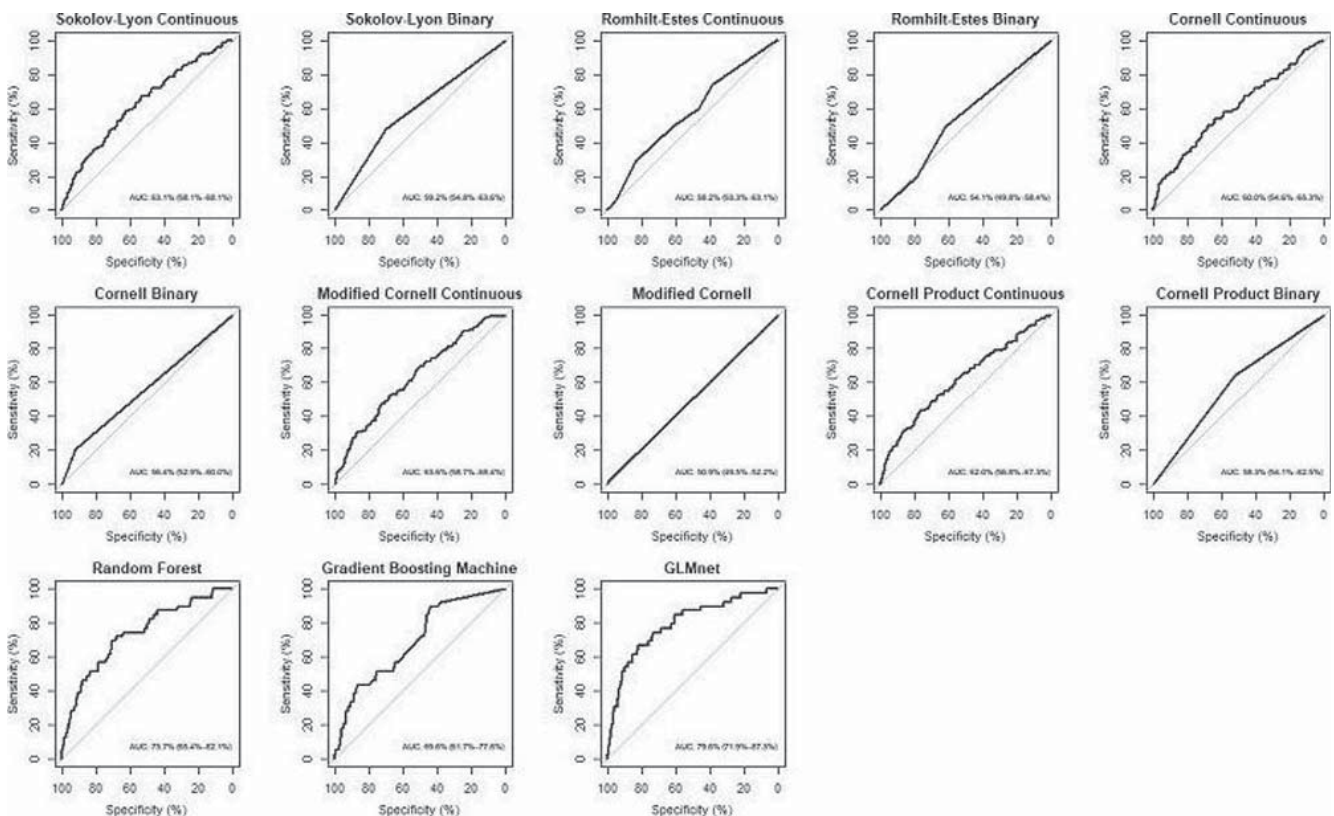
**Aims:** We sought to evaluate the performance of classical criteria against the performance of novel machine learning models in the identification of LVH.

**Methodology:** Between November 2009 and December 2014, pre-participation screening ECG and subsequent echocardiographic data was collected from 13,954 males aged 16 to 22, who reported for medical screening prior to military conscription.

Final diagnosis of LVH was made on echocardiography, with LVH defined as a left ventricular mass index  $>115\text{g/m}^2$ . The continuous and binary forms of classical criteria were compared against machine learning models using receiver-operating characteristics (ROC) curve analysis. An 80:20 split was used to divide the data into training and test sets for the machine learning models, and three fold cross validation was used in training the models. We also compared the important variables identified by machine learning models with the input variables of classical criteria.

**Results:** Prevalence of echocardiographic LVH in this population was 0.91% (127 cases). Classical ECG criteria had poor performance in predicting LVH, with the best predictions achieved by the continuous Sokolow-Lyon (AUC = 0.63, 95% CI = 0.58–0.68) and the continuous Modified Cornell (AUC = 0.63, 95% CI = 0.58–0.68). Machine learning methods achieved superior performance – Random Forest (AUC = 0.74, 95% CI = 0.66–0.82), Gradient Boosting Machines (AUC = 0.70, 95% CI = 0.61–0.79), GLMNet (AUC = 0.78, 95% CI = 0.70–0.86). Novel and less recognized ECG parameters identified by the machine learning models as being predictive of LVH included mean QT interval, mean QRS interval, R in V4, and R in I.

**Conclusion:** The prevalence of LVH in our population is lower than that previously reported in other similar populations. Classical ECG criteria perform poorly in this context. Machine learning methods show superior predictive performance and demonstrate non-traditional predictors of LVH from ECG data. Further research is required to improve the predictive ability of machine learning models, and to understand the underlying pathology of the novel ECG predictors identified.



ROC curves of models studies