MACHINE LEARNING APPLICATION FOR PREDICTING SMOKING CESSATION AMONG US ADULTS

Mona Issabakhsh,[1] Luz M Sánchez-Romero,[1] Thuy TT Le,[2] Alex Liber,[1] Jiale Tan,[2] Yameng Li,[1] Rafael Meza,[3] David Mendez,[2] David Levy[1]

[1] Georgetown Lombardi Comprehensive Cancer Center
[2] University of Michigan School of Public Health
[3] British Columbia Cancer Research Center

JANUARY 2023

Machine learning is a powerful tool to find determinants of smoking cessation and develop accurate predictive models, specifically in large datasets with a vast number of variables.

We used the US nationally representative longitudinal data from the Population Assessment of Tobacco and Health (PATH) study.

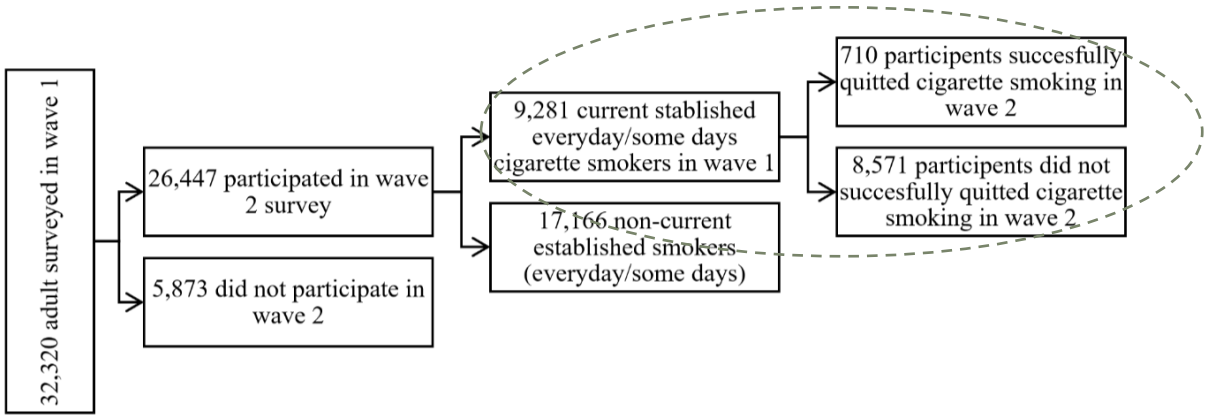


Fig. 1: Analytical sample selection flowchart, PATH survey adults, waves 1 and 2.

Because of the skewed class distribution in our data (only 7% quit rate), we employed random sampling and ensemble-based techniques for feature selection and predictive model training.

Table 2: Evaluation results of the predictive models.

Sample	Model	Sensitivity	Specificity	Balanced Accuracy	ROC-AUC
No Sampling					
	GBM	0.0135	0.9972	0.5054	0.7696
	XGBoost	0.0676	0.9917	0.5296	0.7574
	GLM	0.0495	0.9929	0.5212	0.7392
	RF	0.0045	0.9992	0.5018	0.7584
Over Sampling					
	GBM	0.6712	0.7732	0.7222	0.7757
	XGBoost	0.3108	0.9094	0.6101	0.7021
	GLM	0.6531	0.7165	0.6848	0.7244
	RF	0.0360	0.9948	0.5154	0.7614
Under Sampling					
	GBM	0.7162	0.7114	0.7138	0.7652
	XGBoost	0.7432	0.6937	0.7185	0.7645
	GLM	0.6667	0.6409	0.6538	0.6991
	RF	0.7432	0.6917	0.7175	0.7652
Bagging					
	GBM	0.6824	0.7445	0.7135	0.7631
	XGBoost	0.7008	0.7019	0.7014	0.7557
	GLM	0.6607	0.6637	0.6622	0.7063
	RF	0.7297	0.7146	0.7221	0.7637

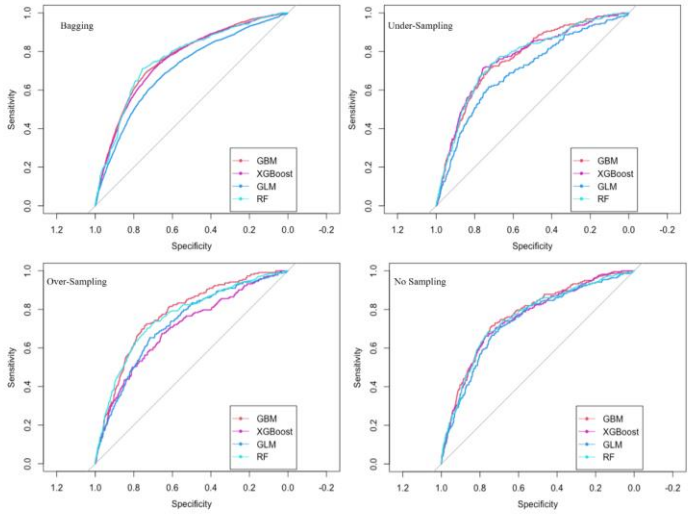


Fig. 4: ROC comparison of the predictive models.

Predictive models with Random Forest, Gradient Boosting Machines, Generalized Linear Regression, and Extreme Gradient Boosting algorithms were developed.

Our analysis indicated that more past 30 days e-cigarette use at the time of quitting, fewer past 30 days cigarette use before quitting, ages older than 18 at smoking initiation, fewer years of smoking, poly tobacco past 30-days use before quitting, and higher BMI resulted in higher chances of cigarette cessation for adult smokers in the US.

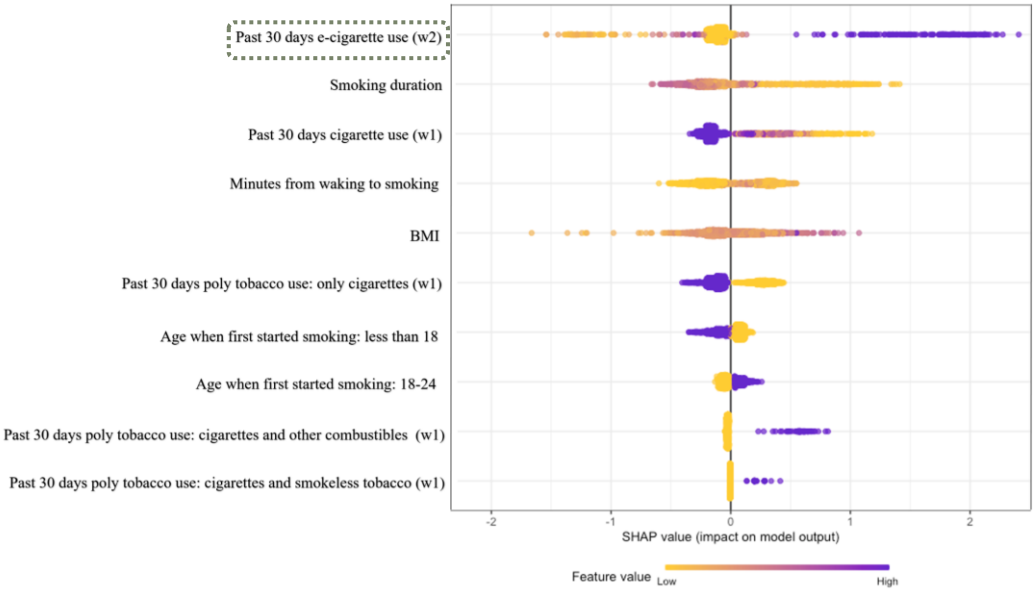
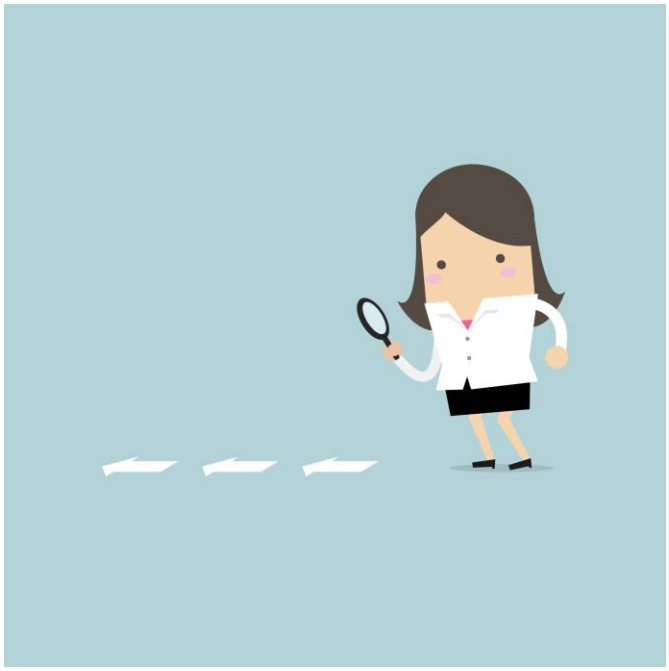


Fig. 3: TreeSHAP summary plot for the combination of the top five variables selected by RF and GBM.

Future Directions

What are the determinants of long-term cessation?



Thank you!

Please read the preprint of our paper for more details about the study:

https://assets.researchsquare.com/files/rs-2285331/v1_covered.pdf?c=1668998388

Funding support is provided by grant U54CA229974 from the National Cancer Institute of the National Institutes of Health and the FDA Center for Tobacco Products.