

# Applications of artificial intelligence techniques in predicting tinnitus intervention outcomes

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## Introduction

- Psychological approaches such as cognitive behavioral therapy (CBT) have the most evidence-base. However, the studies so far have examined group effects and there is little knowledge on the predictors of outcomes.
- Our previous efforts on using traditional statistical methods have not resulted in identification of any key predictors.
- In the current study, **we have applied Artificial Intelligence (AI) techniques on a dataset of individuals who underwent Internet-based CBT (ICBT) to examine the predictors of intervention outcomes** as well as to identify the participant group that are most/least likely to be benefited.

## Method

- 228 individuals with tinnitus who underwent ICBT.
- A **positive treatment effect = 13-points reduction** in Tinnitus Functional Index (TFI) scores.
- Various **demographic, tinnitus related, and comorbidities** (e.g., anxiety, depression, insomnia) were used as predictor variables.
- AI techniques with **various decision trees, and random forest were applied on this data** to examine the predictors of outcomes and to identify participant groups who are most likely to be benefited.

## Results

- The **best model performance** were seen with **CART (AUC:0.69±0.001)** and **GB (AUC:0.68±0.02)** models.
- CART tree depicts **three subject groups** who had shown **at least 85% success with the ICBT intervention**. This includes the **subjects who have had Master’s level education or above**
- SHAP value estimate the importance of each predictor variable** in predicting the ICBT outcome. A larger SHAP values indicate relatively higher importance in their contribution.
- Two features: **education level** and the **baseline tinnitus severity** were identified as the two most important influencing features.

## Conclusions

- Using AI techniques on a larger dataset may provide more clearer understanding of who would benefit from what kind of psychological treatments and will help in fine-tuning the content, presentation, and process-flow of internet-based psychological treatments.

Classification model	Accuracy (%)	Sensitivity (%; True positive rate)	Specificity (%; True negative rate)	Area under the ROC curve (AUC)
CART	70.7±2.4	74.0±5.5	64.0±3.7	0.69 ± 0.001
C5.0	56.3±1.1	68.6±1.9	31.1±6.3	0.52 ± 0.001
Gradient Boosting (GB)	71.8±1.5	78.3±2.8	58.7 ± 4.2	0.68±0.02
AdaBoost algorithm	63.6±3.2	73.3±5.2	44.0±7.8	0.58 ± 0.05
Random Forest (RF)	66.7±3.0	75.0±6.1	50.0±7.2	0.60±0.01

