Eupnoos: Advancing Early Diagnosis of Respiratory Diseases with Smartphone-Based Audio Phenotyping

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Background: Early detection of airway disease is an important public health priority with an urgent need for simple diagnostic tools that are easier to deploy than spirometry. Eupnoos has developed an audio phenotyping platform that can detect spectral patterns in audio data recorded using the MEMS microphone on a smartphone. The algorithms identify and quantify distinct spectral features within human breath sounds potentially facilitating early diagnosis.

Methods: We performed a small-scale research study in conjunction with the University of Southampton (ERGOII 70867) and Care Ashore, with a view to testing the diagnostic accuracy of the Eupnoos technology platform.

The collected dataset consisted of 43 participants who performed three forced expiratory manoeuvres into the MEMS sensor of a mobile phone. The audio files were filtered down to 36 usable files, with one file per participant; for six participants the audio files were unusable and left out during the processing.

The collected data was processed to extract several acoustic spectral features. These features (n=22) were used as inputs into a gradient-boosting classification model with a binary output. Model accuracy was assessed by applying a repeated K-fold cross-validation.

Results: Audio phenotyping platform can demonstrate excellent specificity but limited sensitivity in the classification of both asthma and COPD (**Figure 1**). The mean AUC score (SD) is 0.64 (0.056) for asthma and 0.786 (0.169) for COPD. Algorithm development and model accuracy were limited by the small number of disease cases, necessitating further development of the spectral algorithm in incident asthma and COPD populations.

Conclusion: The results demonstrate promising accuracy in using audio phenotyping for diagnosing asthma and COPD. This work serves as an early proof of concept, highlighting the potential of utilising breath sound to phenotype respiratory diseases.
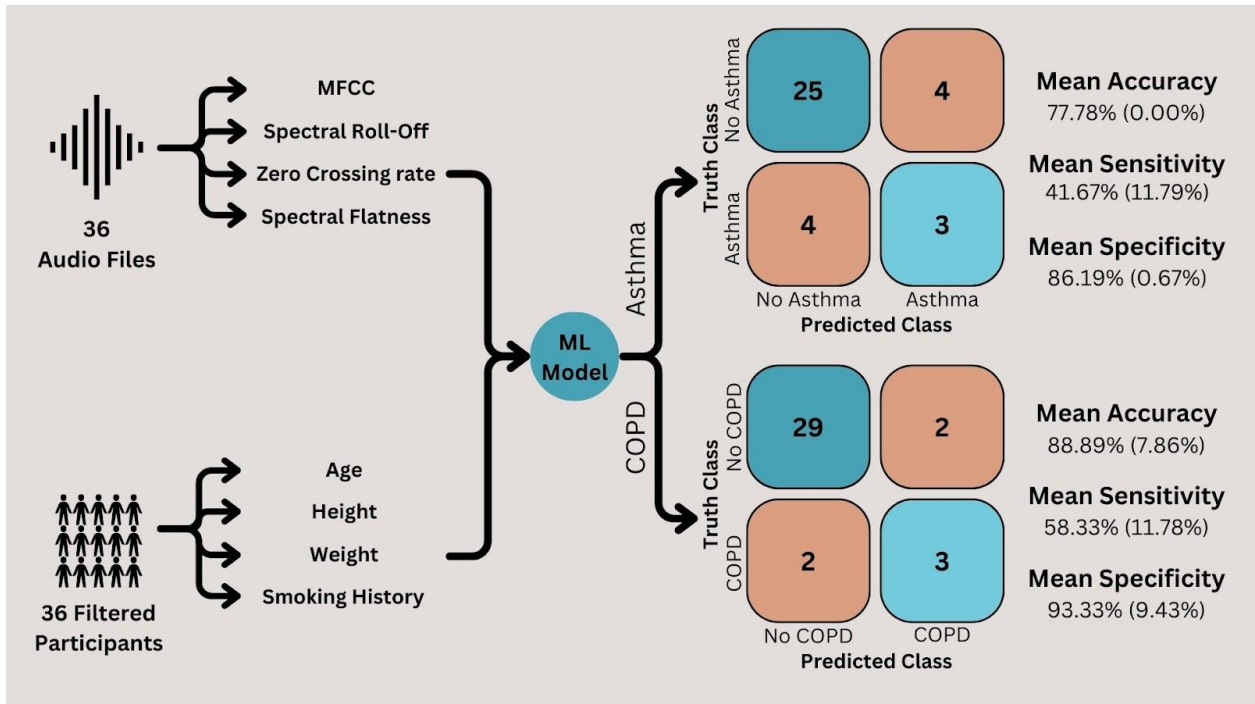
Figure 1: *Resultant confusion matrix of the overall accuracy of the models with the specificity and the sensitivity.*