Frederikke Rosenvinge Skov - abstract til deltagelse i Frie foredrag eller deltage med en poster

Background

Asthma and allergic rhinitis (AR) are common childhood conditions influenced by genetic, environmental, and immunological factors. Traditional statistical methods often fail to capture these interactions. This study aimed to identify early-life determinants of asthma and AR persistence using explainable machine learning models.

Methods

We included 411 children from the Copenhagen Prospective Studies on Asthma in Childhood ($COPSAC_{2000}$) cohort, and categorized them into asthma and AR outcomes. Asthma outcomes included transient (n=54) and persistent asthma (n=92), while AR outcomes comprised late-onset (n=90) and persistent AR (n=31), compared to controls. Four machine learning models—LightGBM, Random Forest, Elastic Net, and Deep Neural Networks—were trained on 97 entry features, including genetic predispositions, environmental exposures, immune markers, lung function, and biometric data. Model performance was evaluated using area under the curve (AUC) and Shapley Additive Explanations (SHAP).

Results

For asthma, the LightGBM model performed best, achieving an AUC of 0.64 for distinguishing between persistent and transient asthma. Key predictors included total IgE at 4 years, dog allergen exposure at 1 year, Maximum Mid-Expiratory Flow (MMEF) at 7 years, early airway infections from 0-3 years, and number of siblings. For AR, the Elastic Net model reached an AUC of 0.59 distinguishing between persistent AR and controls. Post hoc analysis showed that having a parent with AR, higher household income, early airway infections, passive smoking, and exposure to dog allergens made persistent AR more likely, whereas being born in summer and having more siblings made persistent AR less likely.

Conclusion

Machine learning models can identify children at high risk for persistent asthma and AR phenotypes, enabling early targeted interventions like allergen avoidance and management of atopic conditions to reduce disease progression and improve outcomes.