

EP16.54 Early prediction of gestational diabetes using maternal characteristics and first-trimester biomarkers: an interpretable machine learning approach

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Objective: To develop an interpretable machine learning (ML) model integrating maternal characteristics and first-trimester biomarkers for early prediction of gestational diabetes mellitus (GDM).

Methods: This retrospective study included singleton pregnancies undergoing first-trimester screening and subsequent GDM testing at MacKay Memorial Hospital (Jan 2019–Jul 2024). Maternal variables included age, pregestational body mass index (BMI), mean arterial pressure (MAP), and medical history. First-trimester markers included PAPP-A, PIGF, free β -hCG, nuchal translucency, and uterine artery pulsatility index. Data were randomly split into training and testing sets (9:1). To address class imbalance, random oversampling (ROS), random undersampling (RUS), and synthetic minority oversampling technique (SMOTE) were applied.

Eight ML algorithms were evaluated. Performance was assessed using ROC curves and AUCs. Model interpretability was analyzed using SHAP and patient-level heatmaps.

Results: A total of 2,756 pregnancies were included, of which 352 (12.8%) developed GDM. Women with GDM were older and had higher pregestational BMI and MAP. First-trimester levels of PAPP-A, PIGF, and free β -hCG were lower in the GDM group. **Gradient boosting** with **ROS** showed the best performance (**AUC = 0.768**). SHAP analysis identified maternal age, MAP, pregestational BMI, PAPP-A, and PIGF as the main predictors. Saliency heatmaps illustrated individualized feature contributions.

Conclusion: An interpretable ML model integrating maternal characteristics and first-trimester biomarkers showed good performance for early prediction of GDM and may support early risk stratification and preventive intervention before conventional screening.

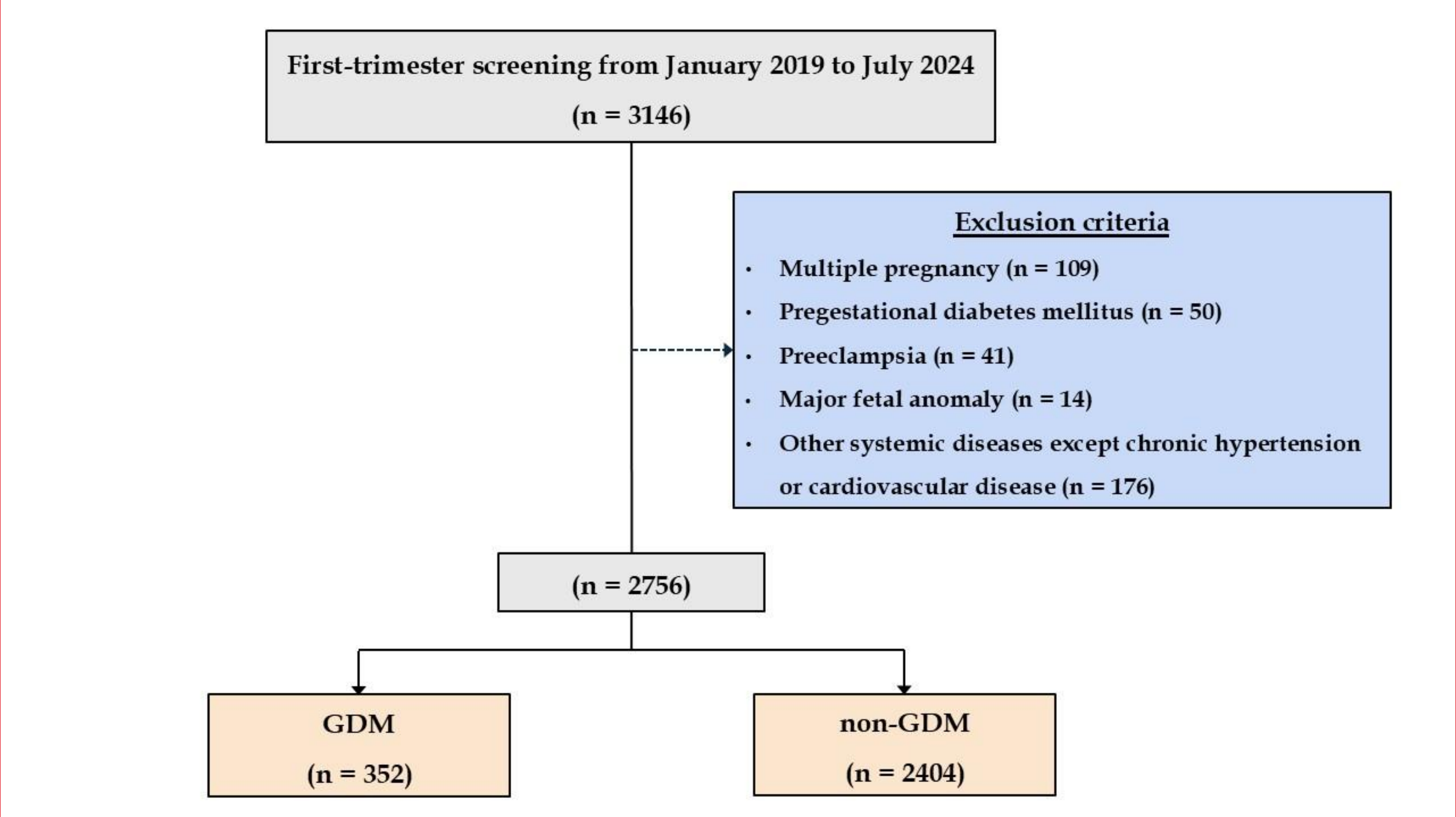


Figure 1. Flowchart of participant selection

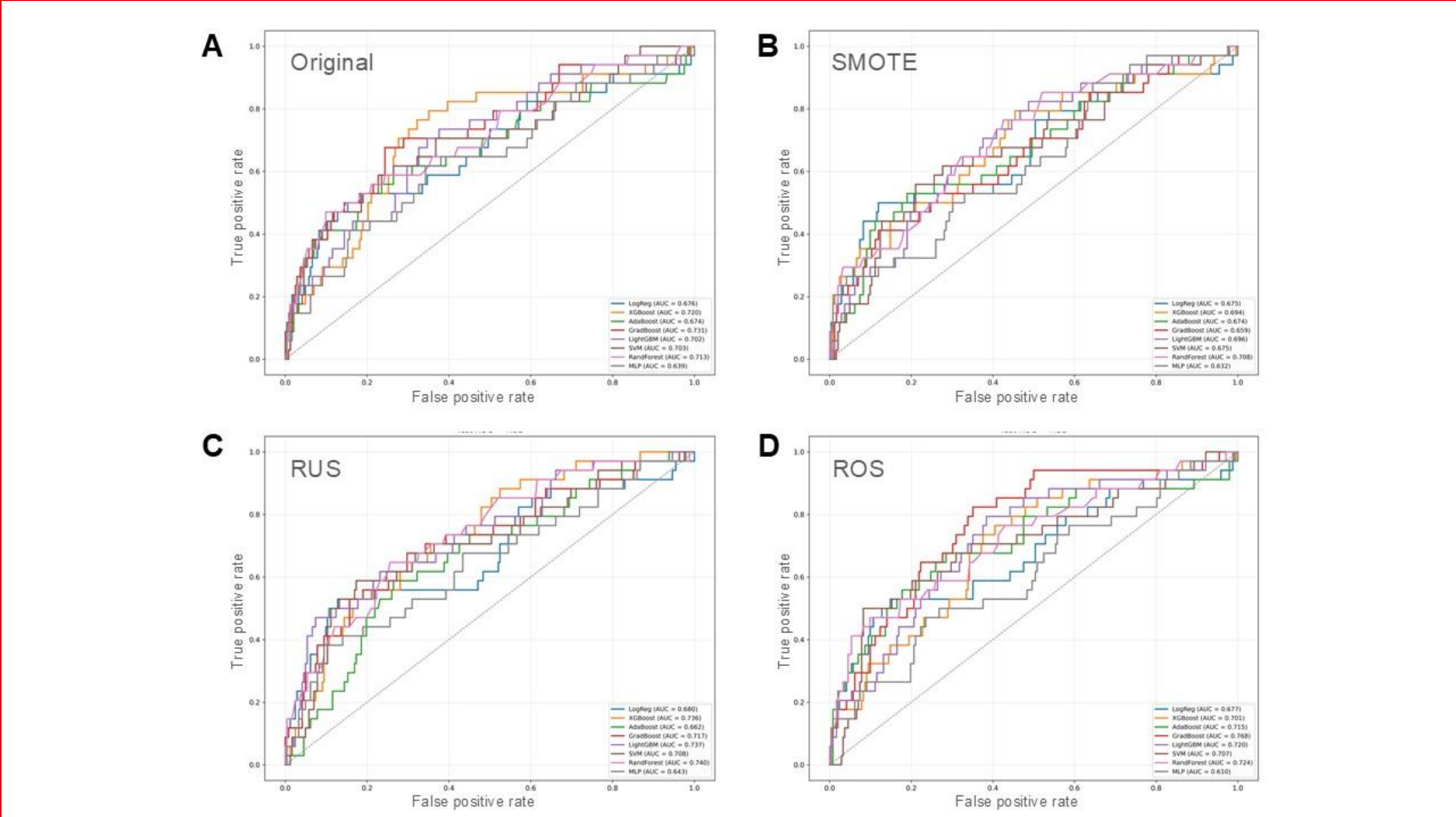


Figure 2. ROC curves of ML models

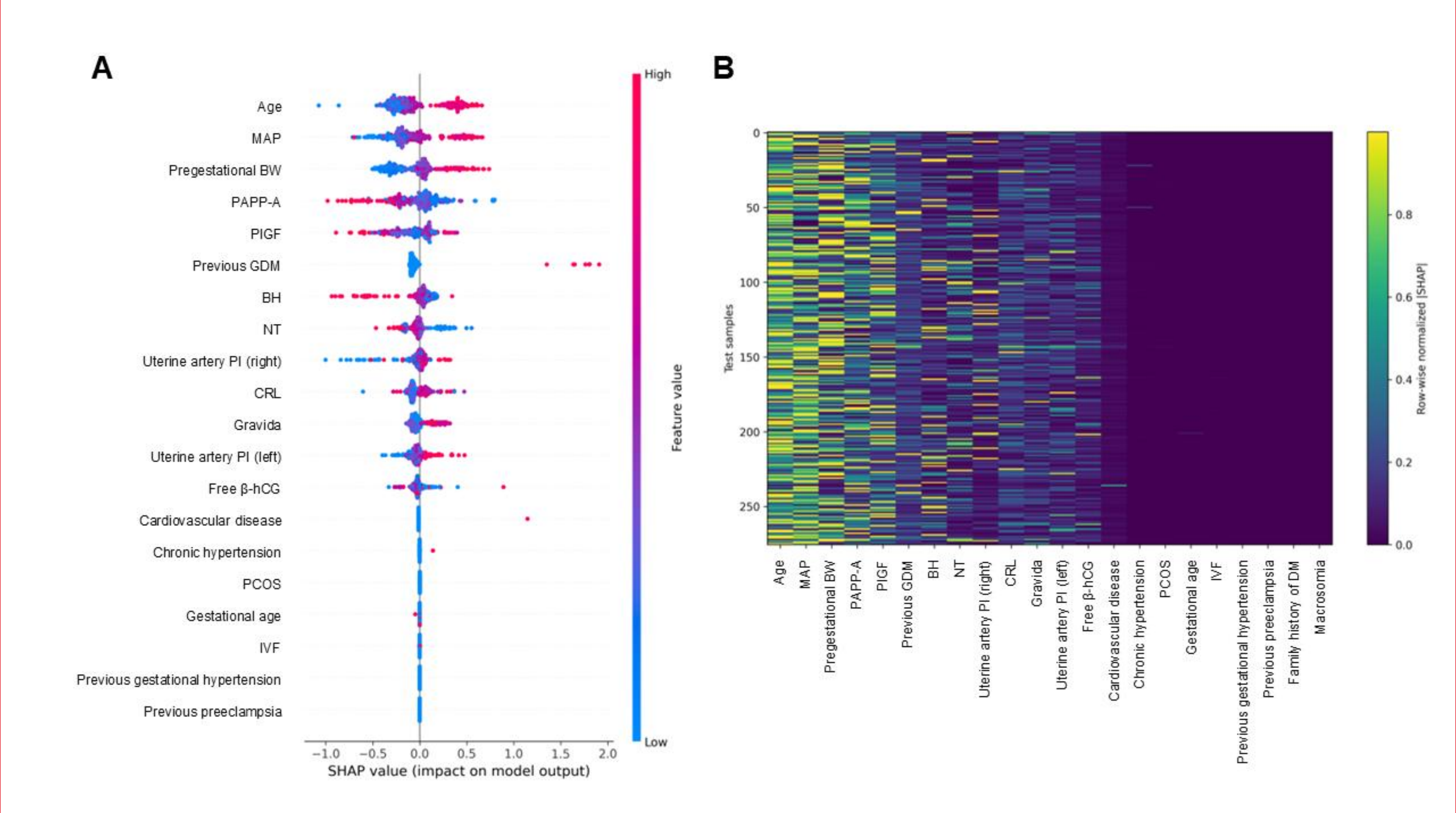


Figure 3. (A) SHAP, (B) patient-level heatmaps