Machine-learning prediction of early postpartum glucose intolerance in women with gestational diabetes mellitus

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Background: Type 2 diabetes (T2D) and cardiovascular disease (CVD) are serious complications of pregnancies with gestational diabetes mellitus (GDM). Around 50% of GDM women develop postpartum glucose intolerance (ppGI) within the first decade of pregnancy with a 10-fold higher risk of future T2D and a 2-fold higher risk of CVD. Therefore, it is crucial to identify women at high risk of ppGI before delivery.

Aim: We aim to stratify GDM women during pregnancy according to their risk of developing ppGI within 6-12 weeks postpartum.

Method: We use retrospective antenatal data consisting of maternal anthropometric and biochemical variables, collected for 607 women diagnosed with GDM from an NHS Trust hospital in the UK. We build a prediction model using sparse logistic regression with nested cross-validation for hyperparameter tuning and model evaluation. We evaluate the performance of the model using metrics such as the area under the receiver operating characteristic (ROC) curve and specificity for predetermined values of sensitivity. We decide the optimal threshold for risk stratification using K-L divergence and information graphs. We perform decision curve analysis to compare the standardized net benefit obtained from implementing our prediction model in comparison with universal screening of GDM women for ppGI.

Results: 92 of the women in the study developed ppGI. Antenatal fasting plasma glucose (A-FPG) at the time of the Oral Glucose Tolerance Test (OGTT) and antenatal HbA1c (A-HbA1c) immediately after the diagnosis of GDM are the only two variables selected by our model in >80% of the iterations. The model has an area under the ROC curve of 0.72. We propose a rule-in diagnostic test with 92% specificity at a probability threshold of 0.381 and a rule-out diagnostic test with 92% sensitivity at a probability threshold of 0.140.

Conclusion: We propose ‘rule-in and rule-out’ approach to predict ppGI. This will allow risk stratification of GDM women before delivery and a targeted, personalized approach. We believe this model is an easy practical tool for healthcare professionals and policy-makers in both high and low-resource settings by varying the threshold at which risk reduction strategies are implemented in GDM women for reducing cardiometabolic outcomes.