Prediction of Large for Gestational Age Infants in Overweight and Obese Women at Approximately 20 Gestational Weeks

Yuhan Du¹, John Mehegan¹, Fionnuala M McAuliffe¹, Catherine Mooney¹
¹University College Dublin, Dublin, Ireland.

Abstract
Large for gestational age (LGA) births are associated with many maternal and perinatal complications. As overweight and obesity are risk factors for LGA, we aimed to predict LGA in overweight and obese women at approximately 20 gestational weeks, so that we can identify women at risk of LGA early to allow for appropriate interventions. A random forest algorithm was applied to maternal characteristics and blood biomarkers at baseline and 20 gestational weeks’ ultrasound scan findings to develop a prediction model. Here we present our preliminary results demonstrating potential for use in clinical decision support for identifying patients early in pregnancy at risk of an LGA birth.

Introduction
Large for gestational age (LGA):
• Infant’s birth weight above 90th percentile for his/her gestational age
• Associated with many maternal and perinatal complications
• Overweight and obese women have higher risks
• Most published models focused on the late stages of pregnancy (26 – 37 weeks)
We aimed to:
• Predict LGA at approximately 20 gestational weeks in overweight and obese women using machine learning
• Advantage: early enough to allow interventions

Method
A randomized controlled trial of an antenatal behavior change intervention to prevent gestational diabetes mellitus in overweight and obese women [1]

Excluded n = 100: Reasons: PEARs study dropouts/exclusions: infant’s birth weight unavailable

Our dataset n = 405
11.18% LGA

Drop predictors with > 20% missing rate; impute missing values in the other predictors with median (numerical) and mode (categorical); Train test split

Training Set n = 349 (75%)
Test Set n = 116 (25%)

Apply random forest algorithm; Synthetic minority over-sampling technique; Feature selection based on variable importance

Random Forest Model

Results
Variable importance plot showing 20 most important features only

Top 10 most important features selected
• Baseline maternal characteristics: maternal height, weight, body mass index (BMI), BMI category, Pobal HP deprivation index
• Baseline blood biomarkers: white cell count
• 20 weeks’ ultrasound findings: head circumference (HC), HC percentile, abdominal circumference (AC) percentile, estimated fetal weight (EFW) percentile

Performance of the model evaluated on the test set

<table>
<thead>
<tr>
<th>Evaluation Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUC-PR</td>
<td>0.27</td>
</tr>
<tr>
<td>AUC-ROC</td>
<td>0.77</td>
</tr>
<tr>
<td>Sensitivity at 5% FPR</td>
<td>0.31</td>
</tr>
<tr>
<td>Sensitivity at 10% FPR</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Discussion
These preliminary results show the potential of applying machine learning in identifying women at risk of LGA in a clinical setting. Further research will be conducted on the selection of features and model validation in other populations.

Acknowledgements
The authors wish to express their appreciation to Dr Maria Kennelly and Dr Kate Ainscough for their contributions to the collection of the PEARS data. The authors gratefully thank Dr Eileen C O’Brien, Ms Cara Yelverton, Ms Sarah Louise Killeen and Ms Shauna Callaghan for helpful discussions.

References