Predicting pre-eclampsia in nulliparous women using routinely-collected maternal characteristics: A model development and validation study

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Background: Guidelines recommend identifying in early pregnancy women at elevated risk of pre-eclampsia. Existing prediction tools perform poorly among nulliparous women.
Aims: 1) Develop and validate a pre-eclampsia risk prediction model for nulliparous women. 2) Compare the model's performance against the existing NICE approach.
Methods: This retrospective cohort study included all nulliparous women who gave birth in three public hospitals, Western-Sydney-Local-Health-District, Australia, 2011-2014. Using births from 2011-2012, we performed multivariable logistic regression incorporating established maternal risk factors to develop, and internally validate, the "Western Sydney (WS) model". The WS model was externally validated using births from 2013-2014, assessing its discrimination and calibration. We fitted the final WS model for all births from 2011-2014, and compared its accuracy with the NICE approach.
Results: Among 12,395 births, 293 women (2.4%) had pre-eclampsia. The WS model included: maternal age, BMI, ethnicity, multiple pregnancy, family history of pre-eclampsia, autoimmune disease, chronic hypertension and chronic renal disease. In the validation sample (N=6201), the model c-statistic was 0.70 [95% CI 0.65–0.75], suggesting good discrimination. The observed:expected ratio for pre-eclampsia was 0.91, and the Hosmer-Lemeshow *p*-value of 0.20 suggesting good calibration. In the entire sample (N=12,395), 374 (3.0%) women had a WS model-estimated pre-eclampsia risk ≥8%, the risk-threshold for considering aspirin prophylaxis. Of these, 54 (14.4%) developed pre-eclampsia (sensitivity 18% [14–23], specificity 97% [97–98]). Using the NICE approach, 1173 (9.5%) women were classified as high-risk, of which 107 (9.1%) developed pre-eclampsia (sensitivity 37% [31-42], specificity 91% [91–92]). The final model showed similar accuracy to NICE approach when using a lower risk-threshold ≥4%.
Conclusions: This WS risk model achieved modest performance for pre-eclampsia prediction in nulliparous women. Although not superior to the NICE approach, the WS model has the advantage of providing individualised risk-estimates to inform decisions for pregnancy surveillance and aspirin prophylaxis.

Keywords
Antenatal care, Australia, maternal health, National Institute of Health and Care Excellence, pre-eclampsia, prediction, risk assessment, risk prediction model