



Prediction of preeclampsia using blood pressure

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Objective

Prediction of preeclampsia is a priority however current clinical factor only models are poorly predictive and comprehensive multi-modal models are expensive and not universally accessible. As part of clinical prediction model development, we aimed to determine associations between blood pressure (BP) measurement before 16 weeks’ gestation and development of preeclampsia, and in particular which BP measure had strongest associations with the development of preeclampsia.

Design

Data from two studies were pooled. Inclusion criteria were singleton pregnancy and booking visit including BP recording before 16 weeks’ gestation. The first dataset comes from women across three metropolitan hospitals in Sydney, Australia (2017-2020) and the second dataset from the INTERBIO-21st study, a research study conducted in five countries examining fetal growth and preterm birth.

Method

Odds ratios (OR) with 95% CI’s were obtained from logistic regression models with the outcome preeclampsia. We explored systolic BP, diastolic BP and mean arterial pressure (MAP) as predictors of preeclampsia. Models were adjusted for age, smoking, body mass index, previous hypertension, previous diabetes, and previous preeclampsia, and included an interaction for parity to enable the comparison of model coefficients between nulliparous and parous women.

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Results

There were 14086 women in the pooled analysis: 11008 women from Sydney data and 3078 from INTERBIO-21st. Table 1. shows women’s baseline characteristics in the studies combined by parity. There were 295 cases of preeclampsia (Table 2.). Of note, the rate of preeclampsia in INTERBIO-21st was 3.4% compared to 1.7% in Sydney data.

The risk of preeclampsia was higher in nulliparous women (n = 7172) compared to parous women (n = 6914) OR (95%CI) 3.40 (2.53, 4.63) after adjusting for confounders. MAP before 16 weeks’ gestation (mean[SD] 78.8[8.6]mmHg) yielded a better model fit than systolic BP or diastolic BP for development of preeclampsia. MAP also had a stronger association with development of preeclampsia in parous women [OR for preeclampsia 2.41 CI (1.97, 2.96) per SD increase in MAP] compared with nulliparous women [OR for preeclampsia 1.56 CI (1.33, 1.81) per SD increase in MAP] (p <0.001).

Conclusions

In this multinational and diverse cohort of women, of systolic BP, diastolic BP and MAP before 16 weeks’ gestation, MAP was most strongly associated with development of preeclampsia. Although the expected association of higher preeclampsia rates in nulliparous women compared to parous women was observed, MAP was more strongly associated with development of preeclampsia in parous women. These findings will now be further explored with serial BP measurements and other clinical predictors in model development; of an affordable and accessible clinical triage tool <16 weeks gestation allowing timely commencement of prophylactic aspirin.

Table 1. Baseline characteristics of studies combined by parity

	Nulliparous	Parous	Overall
N	7172	6914	14086
Studies			
INTERBIO-21st n(%)	1257 (17.5)	1821 (26.3)	3078 (21.9)
Sydney n(%)	5915 (82.5)	5093 (73.7)	11008 (78.1)
Age (years)	31.1 (5.0)	33.3 (4.8)	32.2 (5.0)
Smoking n(%)	325 (4.5)	347 (5.0)	672 (4.8)
BMI (kg/m²)	23.5 (4.2)	24.5 (4.8)	24.0 (4.5)
Parity (median (IQR))	NA	1 (1-2)	0 (0-1)
Previous diagnosis of chronic hypertension n(%)	67 (0.9)	155 (2.2)	222 (1.6)
Prior preeclampsia, eclampsia or HELLP (if parous) n(%)	NA	300 (4.3)	300 (2.1)
Previous diagnosis of Type 1 or Type 2 diabetes n(%)	33 (0.5)	85 (1.2)	118 (0.8)
Prior gestational diabetes (if parous) n(%)	NA	588 (9.5)	588 (4.2)
Baseline systolic blood pressure (mm Hg)	105.7 (11.2)	105.7 (11.8)	105.7 (11.5)
Baseline diastolic blood pressure (mm Hg)	65.0 (8.0)	65.5 (8.5)	65.3 (8.3)
Baseline mean arterial pressure (mm Hg)	78.6 (8.3)	78.9 (8.8)	78.8 (8.6)

Values are mean (standard deviation) unless otherwise specified. IQR = Interquartile interval

Table 2. Outcomes of studies combined by parity

Outcomes (Number of cases (%))	Nulliparous	Parous	Overall
None	6625 (92.4)	6550 (94.7)	13175 (93.5)
Pregnancy induced hypertension	358 (5.0)	258 (3.7)	616 (4.4)
Preeclampsia	189 (2.6)	106 (1.5)	295 (2.1)
Total	7172	6914	14086

Percentages may not add to 100% due to rounding