

# The association of hypertensive disorders in pregnancy with future end-stage renal disease

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## Abstract

### Background

Studies on the association between hypertensive disorders in pregnancy (HDP) and end stage renal disease (ESRD) are limited. This study investigated the ESRD risk for women after delivery with HDP.

### Methods

We used insurance claims data to identify 26,651 women aged 19-40 years old with the history of HDP in 1998-2009, without the baseline history of hypertension, diabetes, kidney disease, or lupus. Frequency matched with age and index year of the HDP women, and 213,397 non-HDP women were randomly selected. Incidence rates of ESRD were compared between the two cohorts. Hazard ratios (HRs) were calculated controlling for demographics and clinical factors.

### Results

Seventy-nine women in the HDP cohort and 45 women in the non-HDP cohort developed ESRD. The incidence was 13.9-fold greater in the HDP cohort than in the non-HDP cohort (4.72 vs. 0.34 per 10000 person-years), with an adjusted HR of 12.4 (95% CI 8.54-18.0) after controlling for urbanization, coronary artery disease, congestive heart failure, hyperlipidemia and abruption. The HR was reduced to 2.72 (95% CI 1.76-4.22) after further controlling for hypertension and diabetes. (Table 2) The incidence of ESRD was elevated for women with recurrent HDP. HDP women with preeclampsia/eclampsia were at higher risk (adjusted HR 14.0, 95% CI 9.43-20.7) than those with only gestational hypertension (adjusted HR 9.03, 95% CI 5.20-15.7).

**Table 1:** Demographic characteristics and comorbidity in cohorts with and without hypertensive disorders in pregnancy.

	Non-HDP		HDP		p-value
	N	%	N	%	
<b>Age, year</b>	1.00				
19 to 24	28,164	13.2	3,515	13.2	
25 to 29	68,695	32.2	8,580	32.2	
30 to 34	74,148	34.8	9,259	34.7	
35 to 40	42,390	19.9	5,297	19.9	
<b>Urbanization level</b>	< 0.0001				
1	68,310	32.0	8,412	31.6	
2	69,253	32.5	8,493	31.9	
3	36,961	17.3	4,586	17.2	
4	25,023	11.7	3,215	12.1	
5	13,812	6.5	1,942	7.3	
<b>Baseline comorbidity</b>					
CAD	88	0.04	11	0.04	1.00
CHF	45	0.02	12	0.05	0.02
Hyperlipidemia	119	0.06	37	0.14	< 0.0001
<b>After the index pregnancy</b>					
CAD	148	0.07	97	0.36	< 0.0001
CHF	131	0.06	130	0.49	< 0.0001
Hypertension	549	0.26	973	3.65	< 0.0001
Preterm delivery	14,091	6.60	6,551	24.6	< 0.0001
Abruption	1,264	0.59	632	2.37	< 0.0001
Diabetes	2,719	1.27	1,181	4.43	< 0.0001

Note: 41 missing for urbanization level. HDP, hypertensive disorders in pregnancy; CAD, coronary artery disease; CHF, congestive heart failure.

**Table 2:** Multivariable Cox's proportional hazard regression analysis for risk of end-stage renal disease in women.

Variable	N	Case	IR	Model 1	Model 2	Model 3	Model 4
				HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
<b>Non-HDP</b>	213,397	45	0.34	1.00	1.00	1.00	1.00
<b>HDP</b>	26,651	79	4.72	14.1 (9.76-10.3)***	12.4 (8.54-18.0)***	2.72 (1.76-4.22)***	1.91 (1.20-3.07)**
<b>HDP episodes</b>							
1	2,4248	69	4.61	13.8 (9.46-20.1)***	12.2 (8.29-17.8)***	2.93 (1.88-4.56)***	2.06 (1.29-3.32)**
≥ 2	2,403	10	5.61	16.5 (8.31-32.7)***	14.5 (7.27-28.9)***	1.74 (0.83-3.63)	1.21 (0.57-2.58)
p for trend			< 0.0001 <sup>1</sup>	< 0.0001 <sup>2</sup>	< 0.0001 <sup>2</sup>	0.002 <sup>2</sup>	0.16 <sup>2</sup>
<b>HDP type</b>							
Gestational hypertension	8,653	18	3.40	10.2 (5.89-17.6)***	9.03 (5.20-15.7)***	1.81 (0.99-3.30)	1.38 (0.74-2.57)
Preeclampsia/eclampsia	17,998	61	5.33	15.9 (10.8-23.3)***	14.0 (9.43-20.7)***	3.19 (2.02-5.02)***	2.17 (1.33-3.54)**
p for trend			< 0.0001 <sup>1</sup>	< 0.0001 <sup>2</sup>	< 0.0001 <sup>2</sup>	< 0.0001 <sup>2</sup>	0.001

IR, incidence rate, per 10,000 person-years; HR, hazard ratio; CI, confidence interval; HDP, hypertensive disorders in pregnancy.

Model 1: crude hazard ratio.

Model 2: adjusted for urbanization, coronary artery disease, congestive heart failure, hyperlipidemia and abruption.

Model 3: adjusted for urbanization, coronary artery disease, congestive heart failure, hyperlipidemia, hypertension, diabetes and abruption.

Model 4: time-dependent model, adjusted for urbanization, coronary artery disease, congestive heart failure, hyperlipidemia, hypertension, diabetes and abruption

<sup>1</sup>Poisson regression; <sup>2</sup>Cox proportion regression

\*\*\*p < 0.0001

**Table 3:** Adjusted hazard ratio of developing end-stage renal disease in women with and without HDP.

	Non-HDP		HDP		Compared to non-HDP	
	Case	IR	Case	IR	Crude (95% CI) HR	Adjusted (95% CI) HR
<b>Hypertension</b>						
No	20	0.15	18	1.13	7.56 (4.00-14.3)***	6.67 (3.48-12.8)***
Yes	25	49.7	61	76.8	1.56 (0.98-2.48)	1.51 (0.95-2.41)
<b>Diabetes</b>						
No	43	0.33	70	4.44	13.6 (9.33-19.9)***	11.9 (8.09-17.6)***
Yes	2	0.85	9	9.14	11.3 (2.44-52.4)**	10.6 (2.31-51.0)**

IR, incidence rate, per 10,000 person-years; HDP, hypertensive disorders in pregnancy; HR, hazard ratio; CI, confidence interval.

<sup>1</sup>Adjusted for urbanization, coronary artery disease, congestive heart failure, hyperlipidemia and abruption.

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.0001

## Conclusions.

Women with HDP are at a high risk of subsequent ESRD. The incidence of ESRD may increase further for women with recurrent HDP.

