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ORIGINAL RESEARCH ARTICLE

Hypertensive disorders of pregnancy and breastfeeding practices: A secondary analysis of data from the All Our Families Cohort

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Abstract

Introduction: Hypertensive disorders of pregnancy occur in approximately 7%–10% of pregnancies and are associated with adverse maternal cardiovascular health outcomes across the lifespan. In contrast, breastfeeding has been associated with a reduction in cardiovascular risk factors in a dose-dependent manner. Despite the potential protective effects of lactation on cardiovascular risk, how hypertensive disorders of pregnancy relate to breastfeeding practices and experiences is not well understood. The aim of this study was to investigate the association between hypertensive disorders of pregnancy and breastfeeding outcomes in the first year postpartum.

Material and methods: We conducted a secondary analysis of prospective data from the All Our Families Cohort, a population-based study conducted in Calgary, Alberta, Canada. Women with a singleton pregnancy (n = 1418) who completed self-report questionnaires at <25 weeks and 34–36 weeks of gestation, and 4 months and 12 months postpartum, and provided consent to link to electronic medical records that identified diagnoses of hypertensive disorders of pregnancy (n = 122). Logistic and multiple linear regression analyses were used to model associations between hypertensive disorders of pregnancy and breastfeeding outcomes. Outcomes included breastfeeding intention, intended duration, exclusive breastfeeding at 4 months, breastfeeding duration at 12 months and breastfeeding difficulties.

Results: Hypertensive disorders of pregnancy were not associated with breastfeeding intention (odds ration [OR] 1.30, 95% confidence interval [CI] 0.47–3.03, P = 0.57), intended breastfeeding duration (b = −3.28, 95% CI −7.04 to 0.48, P = 0.09), or initiation (OR = 0.64, 95% CI 0.29– 1.65, P = 0.32), but were associated with an increase in the odds of non-exclusive breastfeeding at 4 months postpartum (OR = 2.11, 95% CI 1.39–3.22, P < 0.001). Women with hypertensive disorders breastfed for 6.26 (95% CI −10.00 to −2.51, P < 0.001) weeks less over 12 months postpartum, had significantly

Abbreviations: AOF, All Our Families Cohort; BMI, body mass index; CI, confidence interval; EBF, exclusive breastfeeding; HDP, hypertensive disorders of pregnancy; HR, hazard ratio; OR, odds ratio.

higher odds of reporting insufficient milk supply (OR = 1.75, 95% CI 1.19–2.46, $P < 0.05$) and had lower odds of breast and/or nipple pain (OR = 0.66, 95% CI 0.44–0.92, $P < 0.05$) compared with those without hypertensive disorders of pregnancy.

Conclusions: Hypertensive disorders of pregnancy are associated with altered breastfeeding practices and experiences during the first year postpartum. Further research is needed to examine biopsychosocial mechanisms through which hypertensive disorders associate with shorter breastfeeding duration, and to examine whether greater breastfeeding duration, intensity or exclusivity reduces short- or long-term maternal cardiovascular risk.

KEYWORDS
exclusive breastfeeding, high-risk, hypertension in pregnancy, preeclampsia, pregnancy, pregnancy breastfeeding

1 | INTRODUCTION

Hypertensive disorders of pregnancy (HDP; ie chronic hypertension, gestational hypertension, preeclampsia and eclampsia) occur in approximately 7%–10% of pregnancies and are a leading cause of perinatal morbidity and mortality.[1–3] Approximately 16% of maternal deaths in developed countries and up to 30% in developing countries are attributable to HDP.[4] There is strong evidence that HDP are associated with adverse maternal cardiovascular health outcomes as much as 55 years after pregnancy.[5] Previous research has shown that HDP are associated with an elevated risk of cardiovascular disease that ranges from 1.7 (adjusted hazard ratio [HR]; 95% confidence interval [CI] 1.3–2.2) in women with gestational hypertension to 4.4 (adjusted HR; 95% CI, 2.4–7.9) in women with severe or pre-term preeclampsia.[6–8] Cardiovascular disease remains a leading cause of death among women.[9]

In contrast, breastfeeding has been associated with a reduction in cardiovascular risk factors in a dose-dependent manner.[10–12] Epidemiological data have revealed that postmenopausal women who reported lactation for ≥12 months have a reduction in odds of hypertension (odds ratio [OR] 0.89, 95% CI 0.84–0.93) and hyperlipidemia (OR 0.81, 95% CI 0.76–0.87) after adjusting for sociodemographic, family history and lifestyle variables.[10] Similar associations with reduced risk of type 2 diabetes have also been observed.[10,13] Even though women with HDP potentially stand to benefit from the risk reduction afforded by breastfeeding, the breastfeeding practices and experiences of women with HDP remain poorly understood.

There has been some research conducted to examine the impact of HDP on breastfeeding initiation and duration.[14–17] For example, Leeners et al. revealed that women with HDP had lower rates of breastfeeding initiation and were less likely to be breastfeeding at 1 and 3 months postpartum compared with women without HDP.[15] Cordero et al. found no association between severe preeclampsia and breastfeeding initiation among women who were separated from their infants in the immediate postpartum period (ie first 24 h) due to magnesium sulfate treatment, a finding that may be accounted for by the inclusion of only late-preterm infants.[14] Others have found that women with HDP report lower rates of breastfeeding initiation and exclusive breastfeeding (EBF) duration during the first 6 months postpartum relative to normotensive controls.[16,17] Although these studies document differences in breastfeeding outcomes among women with and without HDP, findings are limited by retrospective study design, short follow-up assessments and exclusion of confounding variables, and potential reasons for observed differences are often not considered.

Key message

Associations between hypertensive disorders of pregnancy and breastfeeding practices remain unclear. Findings showed that women with a hypertensive disorder of pregnancy had higher odds of non-exclusive breastfeeding, shorter breastfeeding duration, and experienced different breastfeeding difficulties relative to their unaffected counterparts.

Given the potentially important role of lactation for women with HDP, and the relative paucity of previous research examining the link between HDP and breastfeeding outcomes, the aim of the present study was to investigate the association between HDP and breastfeeding practices during the first year postpartum. Specifically, we evaluated whether pregnant women with HDP, relative to those without HDP, show differences in rates of breastfeeding intention and initiation, intended breastfeeding duration, rates of EBF at 4 months postpartum, reported breastfeeding duration at 12 months postpartum, and breastfeeding difficulties. Our hypotheses were that participants with HDP would report: (1) similar rates of breastfeeding intention and initiation, (2) no difference in prenatal intended breastfeeding duration, (3) lower rates of EBF at 4 months postpartum, (4) shorter breastfeeding duration at 12 months postpartum and (5) higher rates of breastfeeding difficulties, relative to the reference group.

2 | MATERIAL AND METHODS

This was a secondary data analysis of existing data collected as part of the All Our Families Cohort study (AOF).[18] AOF is a Canadian longitudinal prospective pregnancy cohort study that aimed to identify risk factors for preterm birth and to examine perinatal health service use, parental well-being, and maternal, child and family health outcomes. AOF collected data in early and late pregnancy, 4 months postpartum, and 1, 2, 3, 5 and 8 years after delivery. We selected AOF data as it allowed for the analysis of HDP and breastfeeding intention during pregnancy, and of breastfeeding outcomes at two timepoints in the first year postpartum.

Population-based recruitment for the AOF study occurred between 2008 and 2011 in Calgary, Alberta, Canada (population 1.2 million). Recruitment methods, sample characteristics, including study attrition and representativeness, and detailed information on the questionnaires administered have been published elsewhere.[18] In the province of Alberta, approximately 87% of women reported breastfeeding initiation, and approximately 27% reported exclusively breastfeeding for at least 6 months, slightly below the national average (32%).[19]

For the present study, we included data from 1574 participants who completed questionnaires at <25 weeks and at 34–36 weeks of gestation, 4 months and 12 months postpartum, and who had linked electronic medical records. We excluded multiple gestations (n = 11/<1%), as early breastfeeding stresses are different for multiples than singletons, and those for whom electronic medical health record data were not available (n = 145/9.2%), preventing reliable measurement of HDP status, for a final sample of 1418.

2.1 | Measures

Participant demographic and health-related characteristics were retrieved from the self-report questionnaire completed at <25 weeks of gestation, and included maternal age, marital status (ie married/common-law [living with a person with whom you have a conjugal relationship but who is not a spouse], single), education (ie high school or less, some or completed postsecondary), household income (ie <$40 000; $40 000–$79 999; ≥$80 000 CAD), ethnicity, <24.99 kg/m^2) and overweight or obese (BMI >25.00 kg/m^2).[20]

Information regarding the presence of hypertension during pregnancy, gestational age at birth and mode of delivery (vaginal or cesarean delivery) was retrieved from the maternal discharge abstract of the electronic health record. A hypertensive disorder diagnosis was based on the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Version: 2008, Canada (ICD10-CA).[21] Accordingly, gestational hypertension was defined as hypertension (ie systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg) that develops for the first time after 20 weeks' gestation (code 013), and preeclampsia as gestational hypertension with significant proteinuria that can range from moderate to severe (code 014); no cases of eclampsia (code 015) were recorded in this sample, and the code for preexisting hypertension (010) was not indicated. HDP was considered present if preexisting hypertension or codes 013 or 014 were listed on the maternal discharge abstract from labor and delivery for the index pregnancy. Information on the date of diagnosis and disease severity was not available and therefore it was not possible to identify cases of early onset preeclampsia. These definitions are in accordance with the 2014 Society of Obstetricians and Gynaecologists of Canada (SOGC)[1] and the American College of Obstetricians and Gynecologists (ACOG)[22] guidelines for the evaluation, diagnosis and treatment of hypertensive disorders. The division of the HDP variable indicates the research group (present, HDP = 1) and reference group (absent, HDP = 0).

Breastfeeding intention was assessed between 34 and 36 weeks of gestation through two self-report questionnaire items that asked: (1) *Are you planning to breastfeed this baby?* (*Yes/No*) and (2) *If YES, for how many weeks are you planning to breastfeed your baby?* and was treated as both a binary (ie yes/no) and continuous (ie number of intended weeks) outcome. Breastfeeding initiation was determined through one item on the 4-month postpartum questionnaire that asked participants: *Did you breastfeed or feed breast milk to your baby, even if only for a short time? (Yes/No)*, and was treated as a binary outcome.

The assessment of EBF duration was derived from a question at the 4-month postpartum questionnaire that asked: *In the past week, what best describes what your baby was fed?* Response options included: (1) *only breastmilk*, (2) *mostly breastmilk but with small amounts of formula*, (3) *mostly formula but with small amounts of breastmilk* and (4) *only formula*. We collapsed the categories into a binary variable of only breastmilk (EBF) vs all other categories (non-EBF).

Breastfeeding difficulties were assessed through six self-report questionnaire items that measure the presence or absence (ie yes/no response options) of infant and maternal difficulties. Specifically, participants were asked: *As a result of breastfeeding your baby, have you experienced: (1) difficulties with baby such as the baby having trouble latching or having a sleepy baby; (2) discomfort such as swollen breasts, sore nipples or painful breasts; (3) difficulty breastfeeding such as not producing enough milk, or having flat or inverted nipples; (4) being tired or fatigued; (5) infection of some kind; and (6) oversupply of milk, fast let down, etc.*). Question response options were binary (ie yes/no). We collapsed the responses to each question into a binary variable with no reported breastfeeding difficulties coded as 0 and one or more difficulties as 1, and assessed individual difficulties separately in our logistic regression analyses.

Breastfeeding duration at 12 months postpartum was assessed with one question that asked: *Did you breastfeed or feed breast milk to your baby, even if only for a short time? (Yes/No)*. If participants answered yes to this question, they were asked: *How long did you breastfeed your baby (weeks)?"* Participants who reported that they were still breastfeeding were considered to have breastfed for 52 weeks. Breastfeeding duration was treated as a continuous variable.

2.2 | Statistical analyses

Statistical analyses were performed using SPSS 24.0 and RSTUDIO.[23,24] We summarized all pertinent variables using descriptive statistics. All breastfeeding outcomes prespecified based on previous research. We used logistic regression to model the associations between HDP and the dichotomous outcomes of breastfeeding intention, breastfeeding initiation, non-EBF at 4 months postpartum, and breastfeeding difficulties, followed by multiple linear regression to model the association between HDP and intended and reported breastfeeding duration. For breastfeeding difficulties, additional analyses were conducted to examine whether maternal-specific problems were more commonly reported among those with HDP, relative to the reference group. We identified covariates that could potentially confound the relation between HDP and breastfeeding outcomes based on previous research and theoretical relevance, namely maternal age, total annual household income, ethnicity, parity, infant gestational age at birth, mode of delivery, and maternal pre-pregnancy overweight/obesity (ie pre-pregnancy BMI ≥25 kg/m^2). Using a reverse elimination modeling process, the maximum number of possible confounding variables were included in the initial models, and then non-significant variables and those that did not confound the association between HDP and breastfeeding outcomes were removed.[25] Across models, missing data (<5%) were handled by pairwise deletion to maximize the use of available variables in the dataset.

Assumptions of multiple linear regression analyses were checked for models with continuous outcomes (ie intended and 12-month reported breastfeeding duration). For intended breastfeeding duration, the normality of the residuals showed a positive skew and 43 datapoints were identified as statistical outliers using the median absolute deviation.[26] Outlier values occurred in both the research and reference group, were plausible and unlikely due to error, and the exclusion of outlier values led to statistically significant results. Log transformation of intended breastfeeding duration did not change the pattern of results or influence statistical significance, but it did lead to normality of the residuals. Thus, for the association between HDP and intended breastfeeding duration, please note that the model includes outlier values (Table 3).

2.3 | Ethical approval

Ethics approval for the AOF cohort study was granted by the Conjoint Health Research Ethics Board at the University of Calgary, Alberta Canada Conjoint Health Research Ethics Board (Ethics ID: E-22128, Approval date: 7 June 2007). All participants provided informed consent.

3 | RESULTS

Background variables, breastfeeding outcomes and differences between the research and reference groups are presented in Table 1. Participants were predominately white, highly educated, married women who were pregnant with their second child. A majority (69%/*n* = 983) reported an annual household income of $80 000 or more. Pre-pregnancy overweight/obesity (ie ≥25 kg/m^2) was present in 35.6% (*n* = 505) of the sample. Participant age at time of delivery ranged from 18 to 43 years, and gestational age at birth ranged from 23 to 42 weeks of gestation (M = 38.89, SD = 1.85). HDP were present in 8.6% (*n* = 122) of women, which reflects estimates from the Canadian population.[18] Relative to the reference group, participants with HDP reported higher rates of overweight/obesity, primiparity, planned (scheduled) or emergency cesarean delivery, had a shorter median intended breastfeeding duration, and gave birth approximately 1 week earlier.

Analyses of data from the 34–36 weeks of gestation questionnaire showed that majority (95%) of participants reported that they intended to breastfeed their child. Participants intended to breastfeed for a median of 40.00 weeks (range 1–156, interquartile range 24–52). Likewise, almost all (96%) of participants reported that they had breastfed their child, if even for a short period of time. At 4 months postpartum, of those participants who initiated breastfeeding, 57% (*n* = 815) reported EBF their baby within the last week.

Results from logistic regression analyses showed that there was no association between HDP and breastfeeding intention as a binary outcome variable (ie yes/no; OR = 1.30, 95% CI 0.47, 3.03; Table 2), after adjusting for pre-pregnancy overweight/obesity. Participants with HDP reported a three-week shorter median intended breastfeeding duration relative to those without HDP, but this was not statistically significant (*b* = −3.28, 95% CI −7.04, 0.48, *P* = 0.09) after adjusting for parity, pre-pregnancy overweight/obesity, and ethnicity (Table 3). Likewise, rates of breastfeeding initiation were not significantly different among women with HDP relative to those without (OR = 0.64, 95% CI 0.29, 1.65; Table 2), controlling for maternal age, pre-pregnancy overweight/obesity, and parity.

The rate of EBF was significantly lower among women with HDP (36.1% vs 59.5%, χ^2 = 25.88, *P* < 0.001). Participants with HDP had 2.11 times the odds of non-EBF at 4-months postpartum compared to the reference group (OR 2.11, 95% CI 1.39–3.22), adjusting for maternal age, pre-pregnancy overweight/obesity, gestational age at birth, and mode of delivery (Table 2). Participants with HDP also breastfed for 6 weeks less over 12 months postpartum, (*b* = −6.26, 95% CI −10.00 to −2.51, *P* < 0.001), adjusting for maternal age, total household income, pre-pregnancy overweight/obesity and mode of delivery (Table 3).

HDP were not significantly associated with reporting one or more breastfeeding difficulties in general, relative to the reference group (OR 1.11, 95% CI 0.95–1.31) after adjusting for pre-pregnancy overweight/obesity and gestational age at birth. However, when we examined breastfeeding difficulties that are plausibly linked to HDP (ie maternal factors only), women with HDP had significantly higher odds of insufficient milk supply (OR 1.75, 95% CI 1.19–2.46) and lower odds of breast and/or nipple pain (OR 0.66, 95% CI 0.44–0.92), adjusting for pre-pregnancy overweight/obesity (Table 2).

TABLE 1 Maternal, obstetric and breastfeeding characteristics according to hypertensive disorders of pregnancy status in 1418 singleton pregnancies, the All Our Families Cohort, 2008–2012, Canada

Background variables	All participants ($n = 1418$)	Hypertensive disorders of pregnancy[a]		χ^2	t	df	P
		Absent $n = 1296$	Present $n = 122$				
Age (years), M (SD)	31.43 (4.42)	31.39 (4.44)	31.87 (4.31)		−1.17	146.2	0.245
Pre-pregnancy body mass index, *n* (%)				79.69		2	<0.001
Underweight/normal (<24.9 kg/m^2)	885 (62.0)	853 (65.8)	32 (26.3)				
Overweight/obesity (≥25 kg/m^2)	505 (35.6)	417 (32.2)	88 (72.1)				
Missing/undisclosed	28 (2.0)	26 (2.0)	2 (1.6)				
Marital status, *n* (%)				3.70		1	0.055
Married/Common law	1353 (95.4)	1241 (95.8)	112 (91.8)				
Other	62 (4.4)	52 (4.0)	10 (8.5)				
Missing	3 (2.1)	3 (0.2)	0 (0.0)				
Ethnicity, *n* (%)							
White/caucasian	1166 (82.2)	1060 (81.8)	106 (86.9)	1.53		1	0.217
Visible minority	249 (17.6)	233 (18.0)	16 (13.1)				
Education, *n* (%)				0.89		2	0.642
High school		121 (9.3)	10 (8.2)				
Some or complete post-secondary		968 (74.7)	96 (78.7)				
Some or complete graduate school		204 (15.7)	16 (13.1)				
Missing		3 (0.2)	0 (0.0)				
Income, *n* (%)				3.43		2	0.180
<$40000		85 (6.6)	8 (6.6)				
$40000 to $79999		275 (21.2)	17 (13.9)				
≥$80000		892 (71.2)	91 (74.6)				
Missing/undisclosed		44 (3.4)	6 (4.9)				
Parity				11.42		1	<0.001
No previous births	683 (48.2)	606 (47.1)	77 (63.6)				
One or more previous births	724 (51.1)	680 (46.3)	44 (36.4)				
Missing/not recorded	11 (7.6)	10 (7.8)	1 (0.01)				
Gestational age at delivery	38.89 (1.85)	38.99 (1.79)	37.80 (2.17)			137.0	<0.001
Type of delivery, *n* (%)				21.60		2	<0.001
Vaginal	1047(73.8)	972 (75.0)	75 (61.5)				
Planned (scheduled)/emergency cesarean	371 (26.1)	324 (25.0)	47 (38.5)				
Outcome variables							
Breastfeeding intention, *n* (%)							0.42
Yes	1346 (95.0)	1233 (95.1)	113 (92.6)				
No	51 (3.6)	45 (3.5)	6 (5.0)				
Missing/not disclosed	21 (1.5)	18 (1.4)	2 (1.6)				
Intended breastfeeding duration, Median (IQR)[b]	40.00 (24–52)	40.00 (24–52)	30.00 (24–48)	11.58		1	<0.001
Breastfeeding initiation, *n* (%)				0.35		1	0.55
Yes	1363 (96.2)	1250 (96.5)	113 (92.6)				
No	54 (3.8)	45 (3.5)	9 (7.4)				
Infant feeding status at 4-months postpartum, *n* (%)				30.37		3	<0.001

(Continues)

TABLE 1 (Continued)

Background variables	All participants ($n = 1418$)	Hypertensive disorders of pregnancy[a]					
		Absent $n = 1296$	Present $n = 122$	χ^2	t	df	P
Breastmilk only	815 (57.4)	771 (59.5)	44 (36.1)				
Mostly breastfed, small amounts of formula	209 (14.7)	186 (14.4)	23 (18.8)				
Mostly formula, small amounts of breastmilk	75 (5.0)	62 (4.8)	13 (10.6)				
Formula only	232 (16.4)	198 (15.2)	34 (27.9)				
Missing	87 (6.1)	79 (6.5)	8 (6.6)				
Breastfeeding duration at 12 months, M (SD)	28.59 (15.9)	29.18 (15.9)	23.17 (15.2)	3.53		110.02	<0.001
Any breastfeeding difficulties				1.07		1	0.301
Yes	1185 (83.5)	1079 (83.3)	106 (86.8)				
No	233 (16.4)	217 (1.1)	16 (0.1)				

Abbreviation: IQR, Interquartile range.

[a]Participants with preexisting hypertension, gestational hypertension and/or preeclampsia noted on the maternal discharge abstract.

[b]Mood's median test was used to compare median intended weeks of gestation between the research (HDP present) and reference groups.

TABLE 2 Adjusted odds ratios with 95% confidence intervals for breastfeeding intention, initiation, and difficulties and exclusive breastfeeding at 4 months postpartum among women with hypertensive disorders of pregnancy, All Our Families Cohort, 2008–2012, Canada

Breastfeeding characteristic	*n*Adjusted OR					
	HDP Absent	HDP Present	Referent	HDP Present	95% CI (LL, UL)	*p*
Breastfeeding intention			1.00	1.30[a]	0.47, 3.03	0.572
Yes	1127/1165	101/106				
Breastfeeding initiation			1.00	0.64[b]	0.29, 1.65	0.320
Yes	1125/1165	99/106				
One or more breastfeeding difficulties			1.00	1.11[d]	0.95, 1.31	0.195
Yes	1079/1296	106/122				
Perceived insufficient milk supply			1.00	1.75[a]	1.19, 2.46	0.015
Yes	388/1226	54/114				
Breast or nipple pain			1.00	0.66[a]	0.44, 0.92	**0.043**
Yes	802/1226	61/114				
Exclusive breastfeeding at 4 months postpartum			1.00	2.11[c]	1.39, 3.22	**<0.001**
No	771/1217	70/114				

Abbreviations: CI, confidence interval; HDP, hypertensive disorders of pregnancy; LL, lower limit; OR, odds ratio; UL, upper limit.

[a]Adjusted for pre-pregnancy overweight/obesity (BMI ≥25 kg/m^2) and parity.

[b]Adjusted for maternal age at delivery, pre-pregnancy overweight/obesity and parity.

[c]Adjusted for maternal age at delivery, pre-pregnancy overweight/obesity, gestational age at birth (completed weeks), and mode of delivery (vaginal or cesarean).

[d]Adjusted for pre-pregnancy overweight/obesity and gestational age at birth.

4 | DISCUSSION

In this study, women with HDP reported significantly higher rates of overweight/obesity, primiparity and cesarean delivery, and gave birth approximately 1 week earlier, relative to the reference group. Our results indicate that whereas those with HDP had no difference in breastfeeding intention or initiation, HDP was associated with lower odds of EBF at 4 months postpartum and, on average,

TABLE 3 Factors related to intended breastfeeding duration assessed between 34 and 36 weeks' gestation, and to self-reported breastfeeding duration assessed at 12 months postpartum, All Our Families Cohort, 2008–2012, Canada

Variables	*b*	95% CI [LL, UL]	*P*
Intended breastfeeding duration (weeks)			
HDP (1 = present)	−3.28	[−7.04 to 0.48]	0.088
Parity (1 = previous birth)	6.14	[4.10–8.18]	<0.001
Pre-pregnancy overweight/obesity	−2.17	[−4.90 to −0.53]	0.015
Ethnicity (0 = white/caucasian)	−3.28	[−6.17 to −0.81]	0.011
Breastfeeding duration at 12 months			
HDP (1 = present)	−6.26	[−10.00 to −2.51]	<0.001
Maternal age	0.40	[0.15–0.65]	0.002
Total household income	2.44	[0.60–4.29]	0.010
Pre-pregnancy overweight/obesity	−3.16	[−5.42 to −0.91]	0.006
Delivery mode (1 = cesarean)	−2.70	[−5.11 to −0.29]	0.028

Note: HDP, hypertensive disorders of pregnancy. *b* indicates the change in prenatal intended breastfeeding duration and reported breastfeeding duration at 12 months postpartum associated with a one-unit increase in the predictor variable. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.

participants discontinued breastfeeding significantly earlier than those without HDP. Additionally, our findings explore breastfeeding difficulties as a potential reason for observed shortened EBF or breastfeeding duration at 12 months and suggest that women with HDP have higher odds of maternal breastfeeding difficulties such as insufficient milk supply but are less likely to report breast/nipple pain relative to the reference group.

Our results are similar to previous research that has shown an impact of HDP on breastfeeding initiation and continuation early in the postpartum period,[14,15] and add to this literature through the assessment of breastfeeding exclusivity and difficulties and control for potential confounding variables. In contrast to one study,[15] in our sample, women with HDP had similar rates of breastfeeding intention and initiation. This finding likely reflects Canadian population-based increases in breastfeeding initiation over the last 15 years, and that previously reported rates were from the USA, where base rates of breastfeeding initiation are lower than those in Canada (77% vs 89%).[27] Taken together, research findings suggest that women with HDP have different breastfeeding outcomes compared with those without the diagnosis.

The reason that women with HDP have shorter breastfeeding duration and are less likely to be exclusively breastfeeding at 4 months is unknown, but is likely complex and might be due to a physiological impact on milk production associated with risk factors for HDP such as overweight and obesity[28] or to a shorter intended breastfeeding duration at the outset. For example, low milk supply can be attributed to poor infant latch, which creates insufficient milk transfer and thus decreased demand for milk production on the breast;[29] in the vast majority of cases, poor latch is associated with nipple pain, nipple trauma and breast pain.[30,31] In our study, women with HDP had both higher odds of low milk supply and lower odds of pain and nipple trauma than women without HDP, suggesting that the mechanism for low milk supply in this population may not be related to poor infant latch. Further, lactogenesis involves complex cellular metabolism and proliferation of epithelial cell growth, which may be impacted by HDP.[28,32,33] More research is needed to elucidate potential physiological mechanisms for poor milk supply among mothers with HDP and the role of pre-pregnancy overweight/obesity in this association.

It is also plausible that the impact of HDP on breastfeeding outcomes is the result of interactions among biopsychosocial factors that, together, influence breastfeeding practices. Previous researchers have applied a self-efficacy framework to understand how biopsychosocial factors such as maternal confidence influence breastfeeding outcomes.[34,35] Breastfeeding self-efficacy refers to a mother's perceived confidence in her ability to initiate, perform and maintain breastfeeding, and the ability to cope with obstacles.[35] Recent qualitative work has shown that women perceive HDP to have a "whole person" impact that can lead to a disruption in maternal and infant bonding, increased guilt and frustration related to early separation from their infant, and reduced maternal confidence.[36] Within this context, it is possible that maternal and/or obstetrical complications associated with HDP have a detrimental impact on a woman's perceived ability to perform maternal related behaviors such as prolonged breastfeeding. This notion could also account for our finding that women in late pregnancy (ie between 34 and 36 weeks of gestation) with HDP intended to breastfeed for a shorter median duration. How the biopsychosocial consequences of HDP influence breastfeeding experiences and practices represents an additional opportunity for further research.

The strengths of this study include a large sample size with an incidence of HDP that is comparable to established prevalence in the Canadian population.[3] A prospective, longitudinal study design allowed for assessment of breastfeeding intention, duration and experiences across pregnancy and up to the first year postpartum and addresses a gap in this area of research. Although this is a strength of using existing data for secondary analysis, a limitation is that the study was not specifically designed for our research question, so data on important variables that may influence breastfeeding goals and milk supply such as previous cesarean

section, HDP or other medical complications in a previous pregnancy, or antihypertensive medication use were unavailable. Since women reported on their breastfeeding experiences, we also gained a better understanding of the unique breastfeeding difficulties reported by women with HDP, which sheds light on some potential reasons for the observed differences in breastfeeding outcomes.

Although the sample size was large and representative of an urban maternal population,[18] the sample is not highly sociodemographically diverse and therefore generalizability of these results to populations with greater diversity is limited. At the 12-month postpartum assessment, information on breastfeeding duration was retrospectively reported for those who had discontinued breastfeeding prior to self-report questionnaire completion and is therefore subject to recall bias. Finally, although we included prepregnancy BMI as a covariate to account for the role of metabolic health, the variable available for these analyses was categorical and prevented a more nuanced investigation of how HDP may interact with BMI to influence breastfeeding outcomes. Further research is needed to examine whether associations between HDP and breastfeeding practices and experiences are present in more racially and ethnically diverse samples, and to obtain more detailed information on biological and behavioral factors that influence breastfeeding practices.

Since data collection occurred from 2008 to 2011, it is possible that they do not accurately represent rates of breastfeeding among women with HDP. Our results are, however, consistent and comparable to two, more recent studies that evaluated breastfeeding practices among women with HDP during the first 6 months postpartum.[17] Our results add to this work by including a longer follow-up period (ie first 12 months postpartum), and through an examination of the specific types of difficulties faced by women with HDP. Given the increasing rates of HDP and the impact of these disorders on cardiovascular health across the lifespan,[37] our results make a meaningful contribution to a growing literature on how HDP relates to breastfeeding outcomes during the first year postpartum and highlight the need for further prospective, longitudinal and interventional research.

5 | CONCLUSION

Taken together, our results demonstrate that HDP is associated with altered breastfeeding experiences and shorter duration of exclusive breast feeding relative to women without HDP. An accumulation of research indicates that women with HDP represent a specific population of pregnant women that may benefit from targeted interventions in the prenatal and postpartum period to address barriers to EBF, improve the breastfeeding experience and to assist with achieving prolonged EBF. Further research is needed to better understand the biopsychosocial pathways through which HDP is associated with breastfeeding intention and duration, and to determine whether breastfeeding duration and intensity/exclusivity afford cardioprotective benefits for this important subgroup of the pregnant population.

AUTHOR CONTRIBUTIONS

KH: conceptualization, formal analysis, writing – original draft, visualization. KC: conceptualization, investigation, formal analysis, writing – review & editing, supervision. DDC: writing – review & editing. TVN: conceptualization, writing – review & editing. ND: conceptualization, writing – review & editing. LTM: conceptualization, writing – review & editing, supervision. ST: conceptualization, methodology, funding acquisition, project administration, supervision, resources, writing – review & editing.

CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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