Breastfeeding and Maternal Hypertension and Diabetes: A Population-Based Cross-Sectional Study

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Abstract

Objective: This study aimed to assess the association of breastfeeding and maternal hypertension and diabetes in Beijing, China.

Subjects and Methods: A cross-sectional study was conducted in four urban communities of Beijing, China, with 9,128 parous women 40–81 years of age who had had only one lifetime birth. Each participant completed a detailed survey and accepted blood pressure measurement and blood glucose testing. Moreover, self-reported hypertension and diabetes were confirmed by review of medical records.

Results: After the analysis was adjusted for the potential confounders, including age, body mass index (BMI), waist to hip ratio (WHR), working status, educational level, drinking, smoking, family history of hypertension, age of menarche, menopause, oral contraceptive use, age of child-bearing, and postpartum BMI, the odd ratio (OR) of hypertension was 1.18 (95% confidence interval [CI], 1.05–1.32) for women who did not breastfeed, compared with women who did. In addition, the ORs for >0 to 6 months, >6 to 12 months, and >12 months of breastfeeding were 0.87 (95% CI, 0.76–0.99), 0.83 (95% CI, 0.68–1.00), and 0.79 (95% CI, 0.65–0.97), respectively, compared with women who did not breastfeed. With adjustment for age, WHR, working status, educational level, family history of diabetes, and postpartum BMI, women who did not breastfeed increased the risk of diabetes (OR = 1.30; 95% CI, 1.11–1.53) compared with women who did. Moreover, women who breastfed for >0 to 6 months (OR = 0.81; 95% CI, 0.67–0.98) and >6 to 12 months (OR = 0.46; 95% CI, 0.26–0.84) had a lower risk of diabetes, compared with women who did not breastfeed.

Conclusions: Chinese mothers who did not breastfeed were more likely to develop hypertension and diabetes in later life.

Introduction

BOTH HYPERTENSION AND DIABETES are major global public health concerns with high and increasing prevalence. In China, the prevalence of hypertension had a significant increase during the period of 2002–2012,[1] and a significant increase was also found in the prevalence of diabetes over the period of 2000–2010.[2]

Multiple lifestyle factors have been associated with increased risks of hypertension and diabetes. In addition, parous women who had no history of lactation[3] or curtailed lactation[4] were associated with an increased risk of maternal hypertension compared with women who lactated for longer duration. Moreover, women who had never breastfed[5–7] or never exclusively breastfed[8] also had an increased risk of diabetes. At present, studies assessing the association of

breastfeeding and maternal hypertension and/or diabetes are scarce in China. Therefore, we investigated the association between breastfeeding and maternal hypertension and diabetes among 9,128 population-based parous women in Beijing, China.

Subjects and Methods

Study population

This population-based cross-sectional study of parous women (40–81 years old) was conducted in four urban communities of Shijingshan District in Beijing, China. To attain accurate information on breastfeeding duration, those parous women who had had only one lifetime birth were selected in our study. Each participant completed a detailed survey by in-person interviewing. Protocols for this study

were approved by the ethics committee of Peking University Shougang Hospital, and written informed consent was obtained prior to the interview.

Outcome assessment

At baseline, each participant reported whether or not she had ever had a physician diagnosis of hypertension or diabetes. If yes, they were asked what year and at which hospital they received this diagnosis. Self-reported hypertension and diabetes were confirmed by review of medical records. Moreover, all participants accepted blood pressure measurement and blood glucose testing in this study. Blood pressure was measured three times at the right brachial artery by an electronic sphygmomanometer after a 5-minute rest in a seated position before each measurement. The mean of the three readings was used for diagnosis. Systolic blood pressure of ≥ 140 mm Hg and/or diastolic blood pressure of ≥ 90 mm Hg, a confirmed previous physician diagnosis of hypertension, or use of antihypertensive drugs was diagnosed as hypertension. In addition, diabetes was defined by a fasting glucose level of ≥ 7.0 mmol/L or an oral glucose tolerance test with a value of ≥ 11.1 mmol/L, a confirmed previous physician diagnosis of diabetes, or use of antidiabetic medication.

Measurement of covariates

A well-designed questionnaire was used at baseline to collect important information. Anthropometric measurements and information collection were done according to a standard protocol by trained medical investigators. We collected the following covariates in our covariate-adjusted models: age, body mass index (BMI), waist to hip ratio (WHR), working status (yes or no), educational level (none, elementary, middle school, high school, and college), smoking (yes or no), drinking (yes or no), family history, age of menarche, menopause (yes or no), oral contraceptive use (yes or no), age of child-bearing, and postpartum BMI.

Duration of breastfeeding assessment

Information about each participant's reproductive history was collected during the in-person interview. This included age of child-bearing, contraceptive use, age of menarche, menopause status, and postpartum BMI, as well as whether and for how long the participant breastfed her child. The collected information of breastfeeding was then recorded as a categorical variable (none, >0 to 6 months, >6 to 12 months, and >12 months) indicating duration of breastfeeding.

Statistical analysis

The data were analyzed using SPSS version 16.0 software (IBM, Armonk, NY). The normality test was checked for continuous variables. If the data showed a normal distribution, variables were given as mean ± standard deviation values, and one-way analysis of variance with the Least Significant Difference test was used to determine differences among groups. If the data were not distributed normally, the Kruskal–Wallis test was used, and variables were expressed as median values with interquartile range. For categorical variables, they were given as percentages. Chi-squared statistical analysis was used to test the differences in categorical variables. Binary logistic regression was performed to explore risk factors for maternal hypertension and diabetes and was applied to assess differences in the categorical variables of breastfeeding duration after controlling for other confounders. A value of $p < 0.05$ (two-sided) was considered to be statistically significant. A value of $p < 0.10$ (two-sided) was considered to be evidence of statistical trends.

Results

Baseline characteristics of the study subjects

In total, 9,128 parous women who had had only one lifetime birth were eligible for our analysis, including 4,249 women with no history of breastfeeding and 4,879 women who had breastfed. Baseline characteristics of participants according to duration of breastfeeding are shown in Table 1. Compared with women who had breastfed, the parous women with no history of breastfeeding were younger ($p < 0.001$) and had a smaller percentage of smoking ($p < 0.05$) but had a greater percentage of high school education and family history of diabetes ($p < 0.05$ and $p < 0.001$, respectively).

Association of duration of breastfeeding and maternal hypertension

Table 2 presents odds ratios (ORs) and 95% confidence intervals (CIs) for maternal hypertension according to the duration of breastfeeding. Women who did not breastfeed faced an increased risk of hypertension compared with women who did (OR = 1.11; 95% CI, 1.01–1.22; $p = 0.03$) in analyses adjusted for age, BMI, WHR, working status, drinking, and family history of hypertension. When we adjusted the analysis by the potential confounders, including age, BMI, WHR, working status, drinking, family history of hypertension, age of menarche, menopause, educational level, smoking, contraceptive use, age of child-bearing, and postpartum BMI, the OR of hypertension was 1.18 (95% CI, 1.05–1.32; $p = 0.01$) for women who did not breastfeed, compared with women who breastfed.

When the duration of breastfeeding was categorized into four levels (none, >0 to 6 months, >6 to 12 months, and >12 months), those with a duration of breastfeeding of >0 to 6 months had a lower risk of hypertension than women who did not breastfeed (crude OR = 0.83; 95% CI, 0.74–0.94; $p_{trend} = 0.001$). After adjustment for age, BMI, WHR, working status, drinking, family history of hypertension, age of menarche, menopause, educational level, smoking, contraceptive use, age of child-bearing, and postpartum BMI, the ORs of hypertension for >0 to 6 months, >6 to 12 months, and >12 months of breastfeeding were 0.87 (95% CI, 0.76–0.99), 0.83 (95% CI, 0.68–1.00), and 0.79 (95% CI, 0.65–0.97), respectively, compared with women who had not breastfed.

Association of duration of breastfeeding and maternal diabetes

Table 3 presented ORs and 95% CIs for maternal diabetes according to the duration of breastfeeding. With adjustment for age, WHR, working status, educational level, family history of diabetes, and postpartum BMI, women who had not breastfed had an increased risk of diabetes (OR = 1.30; 95% CI, 1.11–1.53; $p = 0.01$), compared with women who had a history of breastfeeding. In addition, after adjustment for the potential confounders, including age, BMI, WHR, working status,

TABLE 1. BASELINE CHARACTERISTICS OF 9,128 PAROUS WOMEN IN THIS CROSS-SECTIONAL STUDY

	Duration (months) of breastfeeding				
	None	>0–6	>6–12	>12	p value for trend
Women (n)	4249	1519	1643	1717	
Age (years)	53.77 (5.09)	53.79 (5.62)	54.78 (6.27)	54.55 (6.01)	<0.001
BMI (kg/m^2)	25.37 (3.70)	25.02 (3.78)	25.47 (3.70)	26.14 (3.77)	<0.001
WHR (cm)	0.86 (0.06)	0.86 (0.06)	0.87 (0.06)	0.87 (0.06)	<0.001
Education (%)					
None	0.15	0	0.62	0.93	<0.001
Elementary	1.08	0.72	2.78	3.61	<0.001
Middle school	27.44	27.39	35.48	37.16	<0.05
High school	56.48	50.43	44.93	47.29	<0.05
College	14.85	21.46	16.19	11.01	<0.001
Retired/not working (%)	85.57	80.78	86.79	86.20	<0.001
Smoking (%)	1.62	1.32	1.95	2.68	<0.05
Drinking (%)	0.92	1.51	1.46	1.57	<0.05
Family history (%) of					
Hypertension	27.58	26.40	26.54	28.07	<0.001
Diabetes	25.79	24.75	21.61	21.72	<0.001
Age (years) of					
Menarche	14.39 (3.20)	14.60 (5.19)	14.82 (4.09)	14.93 (3.45)	<0.001
Child-bearing	26.88 (2.90)	26.62 (2.75)	26.59 (3.07)	26.55 (3.18)	<0.001
Menopause (%)	72.06	69.78	76.38	74.43	<0.001
Contraceptive (%)	2.17	3.89	3.23	2.97	<0.05
Postpartum BMI (kg/m^2)	23.43 (3.39)	23.19 (3.44)	23.35 (3.24)	23.85 (3.36)	<0.001
Hypertension (%)	37.04	32.85	38.34	39.14	<0.05
Diabetes (%)	13.65	10.73	13.57	16.37	<0.001

Data are mean (standard deviation) values or percentages, as indicated.
BMI, body mass index; WHR, waist to hip ratio.

educational level, smoking, drinking, family history of diabetes, age of menarche, menopause, contraceptive use, age of child-bearing, and postpartum BMI, the OR of diabetes was 1.31 (95% CI, 1.11–1.54; $p=0.01$) for women who never breastfed, compared with women who had a history of breastfeeding.

When the duration of breastfeeding was categorized into four levels (none, >0 to 6 months, >6 to 12 months, and >12

months), women with a duration of breastfeeding with >0 to 6 months (OR=0.81; 95% CI, 0.67–0.98) and >6 to 12 months (OR=0.46; 95% CI, 0.26–0.84) had a lower risk of diabetes than women who had not breastfed ($p_{trend}=0.001$), with adjustment for age, WHR, working status, educational level, family history of diabetes, and postpartum BMI. When we adjusted the analysis by the potential confounders,

TABLE 2. ASSOCIATION OF BREASTFEEDING AND MATERNAL HYPERTENSION AMONG 9,128 PAROUS WOMEN IN BEIJING, CHINA

	Model 1		Model 2		Model 3		Model 4	
	Crude OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Breastfeeding								
No	1.01	0.92, 1.10	1.08	0.99, 1.18	1.11[a]	1.01, 1.22[a]	1.18[a]	1.05, 1.32[a]
Yes	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
p value for trend	0.90		0.10		0.03		0.01	
Duration (months) of breastfeeding								
None	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
>0–6	0.83[a]	0.74, 0.94[a]	0.82[a]	0.72, 0.93[a]	0.87[a]	0.76, 0.99[a]	0.87[a]	0.76, 0.99[a]
>6–12	1.06	0.94, 1.19	0.95	0.85, 1.08	0.94	0.83, 1.07	0.83[a]	0.68, 1.00[a]
>12	1.09	0.97, 1.23	1.01	0.90, 1.14	0.90	0.80, 1.02	0.79[a]	0.65, 0.97[a]
p value for trend	0.001		0.01		0.12		0.04	

Model 2 was adjusted for age. Model 3 was adjusted for age, body mass index, waist to hip ratio, working status, drinking, and family history of hypertension. Model 4 was adjusted for all covariates, including age, body mass index, waist to hip ratio, working status, drinking, family history of hypertension, age of menarche, menopause, educational level, smoking, contraceptive use, age of child-bearing, and postpartum body mass index.
[a]Compared with the referent, the p value for this group was <0.05.
CI, confidence interval; OR, odds ratio.

TABLE 3. ASSOCIATION OF BREASTFEEDING AND MATERNAL DIABETES AMONG 9,128 PAROUS
WOMEN IN BEIJING, CHINA

	Model 1		Model 2		Model 3		Model 4	
	Crude OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Breastfeeding								
No	1.00	0.89, 1.13	1.05	0.93, 1.19	1.30[a]	1.11, 1.53[a]	1.31[a]	1.11, 1.54[a]
Yes	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
p value for trend		0.98		0.40		0.01[a]		0.01[a]
Duration of breastfeeding								
None	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
>0–6	0.76[a]	0.63, 0.92[a]	0.75[a]	0.62, 0.90[a]	0.81[a]	0.67, 0.98[a]	0.81[a]	0.67, 0.98[a]
>6–12	0.99	0.84, 1.17	0.92	0.77, 1.08	0.46[a]	0.26, 0.84[a]	0.47[a]	0.26, 0.86[a]
>12	1.24[a]	1.06, 1.45[a]	1.17	0.99, 1.36	0.56	0.31, 1.01	0.57	0.31, 1.02
p value for trend		0.00[a]		0.00[a]		0.01[a]		0.01[a]

Model 2 was adjusted for age. Model 3 was adjusted for age, waist to hip ratio, working status, educational level, family history of diabetes, and postpartum body mass index. Model 4 was adjusted for all covariates, including age, body mass index, waist to hip ratio, working status, educational level, smoking, drinking, family history of diabetes, age of menarche, menopause, contraceptive use, age of child-bearing, and postpartum body mass index.

[a]Compared with the referent, the p value for this group was <0.05.

CI, confidence interval; OR, odds ratio.

including age, BMI, WHR, working status, educational level, smoking, drinking, family history of diabetes, age of menarche, menopause, contraceptive use, age of child-bearing, and postpartum BMI, the ORs of diabetes for >0 to 6 months and >6 to 12 months of breastfeeding were 0.81 (95% CI, 0.67–0.98) and 0.47 (95% CI, 0.26–0.86; $p_{trend} = 0.007$), respectively. Furthermore, in forward conditional logistic regression analysis, we found educational level was a beneficial factor for diabetes. The ORs and 95% CIs for middle school, high school, and college were 0.39 (0.19–0.78), 0.34 (0.17–0.69), and 0.26 (0.13–0.54), respectively.

Discussion

We found a direct association between breastfeeding and maternal hypertension and diabetes among 9,128 parous women in this cross-sectional study. Not breastfeeding was associated with increased risks of maternal hypertension and diabetes. Independently of known risk factors for hypertension and diabetes, women with >0 to 6 months, >6 to 12 months, and >12 months of breastfeeding had lower risks of maternal hypertension than women who had not breastfed. Moreover, women who had a duration of breastfeeding of >0 to 6 months and >6 to 12 months both had decreased risks of maternal diabetes, compared with women who had no history of breastfeeding.

Previous studies have also reported the associations between breastfeeding duration and hypertension. Schwarz et al.[5] assessed the prevalence of hypertension in 139,681 postmenopausal U.S. women, and a dose–response relationship between lactation lifetime and incident hypertension was observed. Lee et al.[3] assessed the incidence of hypertension among 177,749 premenopausal women in the Korean Women's Cohort Study and found lactation was significantly associated with the decreased risk of hypertension (relative risk [RR] = 0.92; 95% CI, 0.90–0.96). In addition, compared with women who had no history of lactation, 1–6 months of lactation decreased the risk of hypertension (RR = 0.90; 95% CI, 0.87–0.93), as did 7–12 months (RR = 0.92; 95% CI, 0.87–0.98) or 13–18 months (RR = 0.93; 95% CI, 0.86–0.99).

In our study, we have also found a significant association between breastfeeding and maternal hypertension in 9,128 parous Chinese women. After adjusting the analysis by the potential confounders, breastfeeding duration with >0 to 6 months, >6 to 12 months, and >12 months all decreased the risk of maternal hypertension, compared with women who did not breastfeed. Hence, our results were basically consistent with those of Lee et al.[3]

The association of breastfeeding and diabetes was previously confirmed in several cohort studies. Stuebe et al.[6] found that longer duration of breastfeeding was associated with reduced incidence of type 2 diabetes in two large U.S. cohorts of women. Villegas et al.[7] found that women who had breastfed tended to have a lower risk of diabetes mellitus than those who had never breastfed (RR = 0.88; 95% CI, 0.76–1.02; p = 0.08) among 62,095 middle-aged women in the Shanghai Women's Health Study. In addition, compared with women who had no history of lactation, a breastfeeding duration of ≥36 months significantly decreased the risk of type 2 diabetes (RR = 0.73; 95% CI, 0.58–0.91). An obvious association between breastfeeding and diabetes was also observed in our study. Moreover, a breastfeeding duration of >0 to 6 months and >6 to 12 months both had lower risks of maternal diabetes, compared with women who had no history of breastfeeding. In our study, diabetes that was confirmed by the hospital record or use of antidiabetic medication and a glucose screening test was not classified into one of the two types. In addition, as this was a cross-sectional survey, most of the covariates we collected indicated the current status of participants (for example, smoking and drinking), whereas several covariates (for example, ages of menarche and child-bearing, postpartum BMI, and duration of breastfeeding) were acquired by recalling and self-reporting, which may bias the real association.

Currently, breastfeeding has received more and more attention in China. Moreover, mothers in several cities of China, for example, Beijing, Qingdao, Fuzhou, etc., have participated in the "lactation flash" to advocate breastfeeding. The results of this study will play a promoting role in the support of breastfeeding.

The mechanisms underlying the associations of breastfeeding and maternal hypertension and diabetes are not clear yet. Meanwhile, converging evidence supports the proposal that the neuropeptide oxytocin plays a crucial role in the control of blood pressure. First, in animal studies, oxytocin administration caused a long-term decrease of blood pressure in rats,[9] and postnatal oxytocin treatment reduced blood pressure in adulthood.[10] In humans, mothers with increased levels of oxytocin were primarily breastfeeding, rather than bottle feeding, and they had lower blood pressure, which suggested oxytocin had an antihypertensive effect.[11] Later, it was found postpartum oxytocin levels were related to the reduction of stress-induced vasoconstriction and norepinephrine, which was the sympathetic marker.[12] In addition, breastfeeding may decrease the risk of diabetes by improving insulin sensitivity and glucose intolerance. In a study of both breastfeeding and nonbreastfeeding nondiabetic women, insulin levels and insulin/glucose ratios were lower in the breastfeeding group.[13] For women with prior gestational diabetes, lactation was associated with increased pancreatic beta-cell function[14] and improved glucose metabolism.[15] Animal studies also suggested breastfeeding increased insulin sensitivity and decreased the plasma glucose concentration.[16] Compared with nonlactating rats, blood glucose levels of lactating rats were decreased 20%, and insulin levels were reduced 35%.[17] As for the long-term effect of breastfeeding, breastfeeding may also influence the levels of sex hormones[18] and pituitary hormones[19,20] and may induce long-term changes in the hypothalamic–pituitary axis.[21]

In conclusion, this cross-sectional study provides evidence that not breastfeeding was associated with increased risks of maternal hypertension and diabetes among parous women in Beijing, China. The causal association between duration of breastfeeding and maternal hypertension and diabetes needs to be confirmed by a large population and multicenter cohort study in China.

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Disclosure Statement

No competing financial interests exist.

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