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## Duration of Lactation and Risk Factors for Maternal Cardiovascular Disease

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### Abstract

**Objective:** To examine dose-response relationships between the cumulative number of months women lactated and postmenopausal risk factors for cardiovascular disease.

**Methods:** We examined data from 139,681 postmenopausal women (median age 63 years) who reported at least 1 live birth upon enrolling in the Women's Health Initiative (WHI) observational study or controlled trials. Multivariable models were used to control for sociodemographic (age, parity, race, education, income, age at menopause), lifestyle, and family history variables when examining the impact of duration of lactation on risk factors for cardiovascular disease, including obesity (body mass index(BMI) at or above 30), hypertension, self-reported diabetes, hyperlipidemia, prevalent and incident cardiovascular disease.

**Results:** Dose-response relationships were observed; in fully-adjusted models, women who reported a lifetime history of more than 12 months of lactation were less likely to have hypertension (OR=0.88, p<0.001), diabetes (OR= 0.80, p<0.001), hyperlipidemia (OR=0.81, p<0.001) or cardiovascular disease (OR= 0.91, p=0.008) than women who never breastfed, but they were not less likely to be obese. In models adjusted for all above variables and BMI, similar relationships were seen. Over an average of 7.9 years of postmenopausal participation in the WHI, women with a single live birth who breastfed for 7-12 months were significantly less likely to develop cardiovascular disease (HR 0.72 (0.53 to 0.97)) than women who never breastfed.

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**Conclusion:** Among postmenopausal women, increased duration of lactation was associated with a lower prevalence of hypertension, diabetes, hyperlipidemia and cardiovascular disease.

## Introduction

Cardiovascular disease (CVD) is the leading cause of death for women in developed nations. As such, it is important to identify behaviors that modify women's risk of CVD. Diet and exercise are widely known to impact CVD, but less is known about the impact a woman's decision to breastfeed her children may have on her future risk of CVD. While breastfeeding is widely acknowledged to benefit infant health, in 2004, only 11% of US mothers exclusively breastfed their infants for the first six months of the infant's life.(1)

Lactation increases a mother's metabolic expenditure by an estimated 480 kcal/day;(2) lactating mothers lose more weight in the postpartum period than women who do not breastfeed.(3) Active lactation has been shown to improve glucose tolerance,(4) lipid metabolism(5) and C reactive protein.(6) Recently, a number of studies have indicated longer range effects of lactation.(7,8)

Whether lactation actually decreases risk of cardiovascular disease and whether the benefits of lactation persist after menopause is unclear. The goal of this study was therefore, to examine the impact of lactation on subsequent risk of obesity, hypertension, diabetes, hyperlipidemia and CVD among 139,681 post-menopausal women.

## Materials and Methods

The Women's Health Initiative (WHI) began in 1994 and consisted of a set of clinical trials and an observational study focused on strategies for preventing chronic disease in postmenopausal women. Detailed descriptions of the design of the WHI and the baseline characteristics of the participants have been previously published.(9,10) Briefly, the WHI involved 161,808 generally healthy postmenopausal women who were 50 to 79 years of age on enrollment. Methods regarding data collection, data management, and assurance of the quality of the data have been published previously.(11,12) At a baseline clinic visit, each woman completed questionnaires regarding medical, reproductive, and family history, medication use, and lifestyle. Participants were then sent annual medical update forms to report any hospitalizations. The occurrence of a wide variety of other outcomes, including myocardial infarction, was also assessed with annual questionnaires. Confirmation of hospitalization and other reported outcomes was based on medical record review.(12) All deaths caused by coronary disease were adjudicated using death certificates, available medical records, and descriptions of events. As of September 2005, for participants in the WHI observational study (OS) and controlled trials (CT) the median duration of follow-up was 7.9 years. At that time, 4.7% and 4.6% of subjects had withdrawn or were alive but lost to follow-up from the OS and CT respectively.

Lactation history was assessed when women enrolled in the WHI by asking women who reported  $\geq 1$  live birth, "Did you breastfeed or nurse any children for at least one month?" Women who responded "yes," were then asked "Thinking about all the children you breastfed, how many months total did you breastfeed? (your best guess)." These responses were then recorded as a categorical variable (none, 1–6 months, 7–12 months, 13–23 months, and  $\geq 24$  months) indicating cumulative lifetime duration of lactation. Age at last lactation was also ascertained as a categorical variable (<20, 20-24, 25-29, 30-34, 35-39, 40-44, and  $\geq 45$ ). To estimate years between last lactation and WHI enrollment, we assigned each woman a mid-interval value as the age she last lactated and subtracted this value from age at WHI enrollment.

In this study we examined five cardiovascular risk factors identified at the baseline clinic visit: obesity, hypertension, diabetes, hyperlipidemia, and a history of CVD prior to enrolling in the WHI. In addition we examined incident CVD over the 7.9 years WHI participants were followed. All incident CVD (coronary heart disease, stroke, congestive heart failure, angina, peripheral vascular disease, carotid artery disease, and coronary revascularization) was validated by physician adjudication using standardized protocols.(12)

Obesity was measured using a body mass index (BMI) calculated from height and weight collected by study staff at baseline clinic visits. When considering obesity as a dependent variable, we compared women whose BMI was  $\geq 30$  to those women whose BMI was  $< 30$ . Women with hypertension were identified as those with a self-reported history of treated hypertension or blood pressure measurements meeting criteria for hypertension.(13) Women with diabetes or hyperlipidemia were identified by self-reported history of need to use a medication to control “sugar diabetes” or “cholesterol.” Medication use was validated on enrollment by nurse examination of medication bottles which subjects were instructed to bring to the enrollment visit. For a subset of women, serum lipid levels were drawn and used to confirm self-reported hyperlipidemia. Women with CVD on enrollment were identified by a self-reported history of myocardial infarction, angina, congestive heart failure, peripheral arterial disease, revascularization, carotid angioplasty, carotid endarterectomy or stroke.

On enrollment, dietary information was collected using a 120-item semi-quantitative food frequency questionnaire developed for the WHI. When adjusting for diet in these analyses, we considered energy, cholesterol, fat, fiber, and sodium intakes. Data on use of aspirin, multivitamins, tobacco, and postmenopausal hormone therapy was also reported on enrollment. Physical activity was also reported on enrollment questionnaires that elicited total hours per week engaged in a specified list of moderate to vigorous activities. The reproducibility and validity of WHI measures of physical activity have been previously described(14). Observational study participants also reported their weight at age 18 and at birth and whether they had been breastfed themselves as an infant.

We excluded subjects who were nulliparous (n=19202) or for whom information on parity (n=973) or duration of lactation (n=1705) was missing. We also excluded 247 parous women who reported only stillbirths.

For each of the 5 outcomes assessed at baseline (obesity, hypertension, hyperlipidemia, diabetes, and a history of CVD), we first examined unadjusted relationships between any history of lactation and then duration of lactation, and the prevalence of cardiovascular risk factors. We then constructed multivariable logistic regression models to examine the relationship between duration of lactation and each of these outcomes while adjusting for sociodemographic variables (age, parity, race/ethnicity, income, education). Next we examined models additionally adjusted for lifestyle variables (diet, physical activity, smoking, use of postmenopausal hormone therapy, aspirin, or a multivitamin) and family history (of diabetes, myocardial infarction, or stroke).

As obesity has been closely linked to CVD,(15) for all outcomes other than obesity, we further examined models adjusted for all of the above variables and BMI (measured using categories of BMI  $< 25$ ,  $25 < 30$ , and  $\geq 30$ ). As weight at age 18, birth weight, and whether a woman was breastfed herself in infancy(15) may also affect subsequent risk of CVD, we examined the relationship between duration of lactation and each of these outcomes when these additional self-reported variables were added to models.

We used Cox proportional hazard models to compute hazard ratios (HR) for incident CVD, adjusting for covariates as described above. The proportional hazards assumption was met by testing for interaction of lactation duration with the time variable. In addition, we performed

an analysis in which we examined the subgroup of 126,020 women who reported no CVD on enrolling in the WHI.

As prior work has shown that the benefits of lactation may decrease with time since lactation, (7) and that there is significant racial variation in rates of breastfeeding,(16) we examined our data stratified by age, age at last lactation, parity and race.

Finally, we used multivariate generalized linear models to estimate adjusted prevalence ratios. For all models, to test for dose-response relationships, we examined linear trends across categories of increasing duration of lactation by modeling the categorical breastfeeding duration variable as a continuous variable. All analyses were conducted using SAS version 9.1 (SAS Institute, Cary, NC). Participants with missing covariate data were dropped from analyses involving that covariate. The Institutional Review Board of the University of Pittsburgh approved this study.

## Results

This analysis included 139,681 women with  $\geq 1$  live birth and no missing information on lactation (59,769 women who participated in the WHI CT, 79,912 who participated in the WHI OS). Sociodemographic characteristics of the post-menopausal study participants are shown in table 1. The majority of patients (58%) reported some history of lactation, but only 6% had a cumulative history of lactation greater than 24 months. Few women reported 12+ months of lactation per live birth. On average, 35 years had passed since women had lactated when they enrolled in the WHI.

On enrollment in the WHI, 30% of women were obese ( $BMI \geq 30$ ). In age-adjusted analyses, we found parous women were more likely to be obese or hypertensive than nulliparous women. However, parous women who had lactated were less likely to be obese or have hypertension than parous women who had not lactated. In similar, age-adjusted models, we found the prevalence of diabetes and hyperlipidemia was not significantly different among nulliparous or parous women who had lactated. However, parous women who had not lactated were more likely to have diabetes or hyperlipidemia than parous women who had lactated.

Table 2 shows the relationship between duration of lactation and obesity among parous women. Increasing duration of lactation was associated with a lower prevalence of obesity in the univariable model and in the model adjusted for sociodemographic variables. After additional adjustment for lifestyle and family history variables, however, we did not find a significant relationship between 6 or less, or 24+ months lactation and prevalence of post-menopausal obesity; with 7-23 months of lactation there was a trend towards less obesity ( $p=0.07$ ).

Increasing duration of lactation was associated with a reduced prevalence of cardiovascular risk factors including hypertension, diabetes, and hyperlipidemia, even after adjustment for sociodemographic variables, lifestyle variables, family history, and BMI category ( $p < 0.01$  for all tests for trend, table 3). Similarly, increasing duration of lactation was associated with a lower prevalence of CVD prior to enrolling in the WHI ( $p < 0.01$  for all tests for trend, table 4). Women who reported a lifetime history of more than 12 months of lactation were less likely to have hypertension (OR=0.88,  $p < 0.001$ ), diabetes (OR= 0.80 ,  $p < 0.001$ ), hyperlipidemia (OR=0.81,  $p < 0.001$ ) or cardiovascular disease (OR= 0.91,  $p = 0.008$  ) than women who never breastfed. When compared to women who had never breastfed, women who reported a cumulative lifetime duration of lactation of  $\geq 13$  months were less likely to have developed CVD prior to enrolling in the WHI (OR=0.91, 95% CI= 0.85 to 0.98,  $p = 0.008$ ). Based on multivariate adjusted prevalence ratios from generalized linear models, we estimate that among parous women who did not breastfeed compared to those who breastfed for more than 12 months, 42.1% vs. 38.6% would have hypertension, 5.3% vs. 4.3% would have diabetes, 14.8%

vs. 12.3% would have hyperlipidemia, and 9.9 vs. 9.1% would have developed cardiovascular disease, although 30% of each group would be obese when postmenopausal.

When examining fully-adjusted models of the duration of lactation and prevalence of CVD, we found no significant interactions between age at last lactation ( $p$  for interaction=0.58), race/ethnicity ( $p$  for interaction=0.35), or history of tobacco use ( $p$  for interaction=0.65). However, there was a significant interaction with respect to age ( $p$  for interaction=0.02). In fully-adjusted analyses stratified by age, we found the cardiovascular benefits of lactation decreased as women aged; women who were 50-59 years of age on enrolling in the WHI who reported a cumulative history of lactation of  $\geq 7$  months were significantly less likely to have CVD than similarly-aged women who had never breastfed (OR (95% CI)=0.84 (0.71 to 0.99), 0.80 (0.65 to 0.97), and 0.75 (0.58 to 0.96) for women who had breastfed for 7-12 months, 13-23 months, and 24+ months, respectively). Among women aged 60-69, only those who reported 13-23 months of lactation were significantly less likely than women who had never breastfed to have developed CVD, OR=0.85 (0.75 to 0.96), and among women aged 70-79 there were no significant relationships between duration of lactation and prevalent CVD.

The majority of participants in the WHI OS (58%) reported they had been breastfed as an infant; when we added this variable to analyses in which we adjusted for weight at age 18 and/or weight at birth with and in place of BMI category on enrollment in addition to sociodemographic, family history, and other lifestyle variables, we saw similar relationships between duration of lactation and risk of hypertension, diabetes, hyperlipidemia (data available on request). However, the association with CVD was somewhat attenuated and not statistically significant in the smaller population of OS participants.

When we used Cox models to look at incident CVD over the 7.9 years WHI participants had been followed, we found duration of lactation was associated with a decrease in incident CVD in univariable but not adjusted models (table 4). However, again, there was an interaction with age ( $p$  for interaction=0.04, without adjusting for BMI category;  $p$  for interaction=0.06, with adjustment for BMI category); when we stratified the adjusted model by age, we found more cardiovascular benefits of lactation among younger women. Among women who were 50-59 on enrollment, when compared to women who never lactated, women with a lifetime duration of 7-12 months of lactation were less likely to develop CVD (HR=0.79, 95% CI 0.66 to 0.94, without adjusting for BMI category; HR=0.80, 95% CI 0.67 to 0.95, with adjustment for BMI category) as were women with 24+ months of lifetime lactation (HR=0.66, 95% CI 0.50 to 0.86 without adjusting for BMI category; HR=0.68, 95% CI 0.52 to 0.89, with adjustment for BMI category),  $p$  for trend among women aged 50-59 on enrollment=0.001. Among women who were older than 60 when they enrolled in the WHI, duration of lactation was not associated with incident CVD.

When we stratified the Cox models by parity ( $p$  for interaction=0.06 without adjusting for BMI category,  $p$ =0.07 with adjustment for BMI category), we found that when compared to women who never lactated, women with one live birth who breastfed for 7-12 months were significantly less likely to develop CVD (HR 0.72 (0.53 to 0.97), while among women with 2 or 3 live births, lactation was only associated with a significant reduction in incident CVD if the woman reported 24+ months of lactation (for 2 live births, HR=0.58 (0.35 to 0.95), for 3 live births, HR=0.78 (0.63 to 0.98)).

In analyses of the subgroup of women who had not developed CVD prior to enrolling in the WHI, duration of lactation was not associated with incident CVD.



## Discussion

This study found that women who breastfed their children were less likely to have developed hypertension, diabetes, hyperlipidemia, or CVD when post-menopausal. Women who reported longer histories of lactation had significantly lower rates of risk factors for CVD even after adjusting for sociodemographic and lifestyle variables, family history, and BMI category. Women who had a cumulative lifetime duration of lactation greater than 12 months were approximately 10% less likely to have developed CVD than parous women who never breastfed. While the American Academy of Pediatrics, in the interest of promoting child health, recommends breastfeeding for the first 12 months of an infant's life,(17) our study shows this recommendation also benefits maternal health. If a randomized trial were to find similar effect sizes when comparing women who breastfed more than 1 year to those who never breastfed, we roughly estimate the number needed to treat to prevent a case of maternal hypertension would be 29, to prevent a case of hyperlipidemia would be 40, to prevent a woman from developing diabetes would be 100, and to prevent a case of CVD would be 125. These findings build on a growing body of literature that demonstrates that lactation has beneficial effects on blood pressure,(18) risk of developing diabetes,(7,8) and lipid metabolism.(19) It is known that fat stores accumulate during pregnancy,(20) and prior studies have shown that in populations where breastfeeding is rare, pregnancy may increase risk of CVD.(21) It has been hypothesized that lactation may reduce cardiovascular risk by mobilizing accumulated fat stores. However, our finding that women who breastfed had lower rates of CVD after adjustment for BMI category indicates that lactation does more than simply reduce a woman's fat stores. Hormonal effects, such as those of oxytocin, may have significant effects on cardiovascular profiles. While some have considered lactation's reduction of gonadal hormones to be similar to menopause, which increases risk of CVD, we paradoxically found lactation to protect from CVD, although these benefits appear to wane as women reach 70 years of age, and the time since a woman lactated increases.

Strengths of this study include the large and racially diverse group of women who participated in the WHI. However, all observational studies may be subject to residual confounding. Lifetime duration of lactation, as well as history of diabetes, hyperlipidemia, and prevalent CVD were all self-reported. The measure of lactation used in this study does not allow estimation of the intensity or exclusivity with which women breastfed their infants. It is likely that more powerful effects would be seen with exclusive breastfeeding. Recall or reporting bias may have led to some misclassification of women's lactation history. Prior research has found that women with shorter durations of lactation tended to over-report, while women with longer durations tended to underreport (22). Presuming this misclassification is nondifferential with respect to the outcomes examined, it would attenuate estimates of dose-response associations between duration of lactation and later health. Nonetheless, we observed significant dose-response associations between duration of lactation and risk factors for CVD. Some have hypothesized that women who are able to prolong breastfeeding may lead "less stressful" lives, which may lower their risk of CVD.(23) While we controlled for socioeconomic variables (education, income, race, parity, and tobacco use) which have been associated with life stress,(24) other factors may remain. In addition, studies have linked obesity and insulin resistance to difficulties with breastfeeding,(25) suggesting that decreased duration of lactation could be a marker for an existing abnormal metabolic profile. Regrettably, data on maternal cardiovascular risk at the time of lactation was not collected by the WHI. Women who were breastfed by their mothers may be more likely to breastfeed their children. (26) If early life exposure to breast milk affects cardiovascular risk profiles later in life, models without this variable may be subject to residual confounding. Our models which included this variable were similar to other estimates, in keeping with other recent studies that have provided little evidence of a protective influence of being breastfed on CVD risk factors, incidence, or mortality later in life.(27)

In conclusion, this study shows that lactation may play a significant role in reducing risk of CVD. This implies that recommendations that women breastfeed their infants for the first year of life should be endorsed for the benefit of both maternal and child health.

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Characteristics of Women enrolling in the WHI Observational Study or Controlled Trial who reported one or more live births (N=139,681)

Table 1

	No lactation N=58526	Any lactation N=81155	1-6 months N=41151	7-12 months N=17639	13-23 months N=13604	24+ months N=8761
<b>AGE</b> mean (SD)	62.9 (7.0)	63.6 (7.2)	63.8 (7.2)	63.3 (7.4)	63.4 (7.2)	63.6 (7.3)
<b>AGE at menopause</b> mean (SD)	47.9 (6.5)	48.5 (6.3)	48.1 (6.5)	48.5 (6.2)	49.0 (5.9)	49.3 (6.0)
<b>PARITY</b> mean live births (SD)	2.8 (1.4)	3.3 (1.6)	3.0 (1.5)	3.2 (1.4)	3.5 (1.4)	4.6 (1.7)
<b>RACE</b> (%)						
Native American	0.4	0.5	0.5	0.4	0.4	0.8
Asian/Pacific Islander	1.7	3.1	3.1	3.3	2.6	3.5
Black	9.3	8.3	9.1	8.7	6.0	7.4
Hispanic/Latina	3.6	4.3	4.2	4.2	3.5	6.0
White	83.7	82.4	81.6	82.1	86.1	80.9
Other	1.3	1.4	1.4	1.3	1.4	1.5
<b>EDUCATION</b> (%)						
< high school	5.3	5.7	5.6	5.7	4.6	8.4
High school /GED	22.1	15.2	17.4	14.0	12.1	12.8
Vocational/training school;some college;associates degree	41.1	37.7	40.7	35.4	34.4	33.0
College graduate	31.5	41.4	36.4	44.9	48.9	45.9
<b>INCOME</b>						
Less than-\$34,999	40.9	41.2	43.0	38.9	37.3	43.5
\$35,000-\$74,999	41.5	39.4	39.4	39.7	39.9	37.5
\$75,000+	17.7	9.5	17.7	21.4	22.7	9.0
<b>SMOKING</b>						
Never smoked	47.7	53.5	50.3	54.1	56.4	62.5
Past smoker	44.5	40.3	42.4	40.1	38.6	33.6
Current smoker	7.9	6.2	7.3	5.9	5.0	3.9
<b>POSTMENOPAUSAL HORMONE USE</b>						
Past user	16.0	16.2	16.8	15.8	15.5	14.7

	No lactation N=58526	Any lactation N=81155	1-6 months N=41151	7-12 months N=17639	13-23 months N=13604	24+ months N=8761
Current user	39.7	40.9	41.3	41.7	41.5	36.1
<b>ASPIRIN USE</b>	19.9	20.6	20.7	20.1	21.0	20.6
<b>MULTIVITAMIN</b>	38.1	39.7	39.6	40.0	40.4	38.1
<b>FAMILY HISTORY OF</b>						
Diabetes	35.4	33.0	34.0	32.3	31.0	32.6
Stroke	37.6	38.7	38.9	38.5	38.4	38.5
Myocardial infarction	53.5	51.7	52.7	50.3	51.4	50.4
<b>PHYSICAL ACTIVITY</b>						
MET hours/week mean (SD)	12.0 (13.5)	12.8 (13.8)	12.3 (13.6)	13.1 (13.8)	13.5 (14.1)	13.1 (14.4)
<b>DIETARY INTAKES</b>						
Energy, kcal mean (SD)	1616 (647)	1663 (641)	1639 (642)	1660 (623)	1704 (641)	1718 (649)
Fiber, g mean (SD)	15.4 (6.6)	16.6 (6.9)	16.0 (6.7)	16.6 (6.9)	17.3 (7.1)	17.6 (7.4)
Total fat, g mean (SD)	61.1 (33.2)	61.6 (32.5)	61.3 (32.8)	61.0 (31.7)	62.4 (32.5)	63.2 (32.7)
Cholesterol, g mean (SD)	219 (130)	222 (131)	221 (131)	220 (130)	224 (129)	228 (133)
Sodium, mg mean (SD)	2702 (1153)	2784 (1160)	2741 (1157)	2779 (1146)	2852 (1159)	2886 (1191)
<b>Body mass index</b> mean (SD)	28.2 (6.0)	27.9 (5.8)	28.0 (5.9)	27.8 (5.8)	27.7 (5.7)	28.2 (5.9)

**Table 2** Association between months of lactation and obesity on enrolling in the Womens Health Initiative Observational Study or Controlled Trial

Number of months of lactation	OR	95% CI	p-value	p-trend
Adjusted for age, parity, race, education, income, smoking	Never	.	.	0.001
	1-6 months	0.97	1.00	0.07
	7-12 Months	0.92	0.96	<.0001
	13-23 Months	0.92	0.96	0.0002
	24+ Months	0.99	1.04	0.69
Adjusted for socio-demographic, family history, and lifestyle variables*	Never	.	.	0.28
	1-6 months	1.00	1.03	0.84
	7-12 Months	0.96	1.00	0.07
	13-23 Months	0.95	1.00	0.07
	24+ Months	1.02	1.09	0.56

\* Specifically, age, race, parity, age at menopause, education, income, family history (of diabetes mellitus, myocardial infarction or stroke), physical activity, energy, cholesterol, fat, fiber, and sodium intakes, tobacco history, hormone replacement therapy use, aspirin use, multivitamin use.

**Table 3**

Association between duration of lactation and self-reported history of Hypertension, Diabetes, or Hyperlipidemia on enrolling in the Womens Health Initiative Observational Study and Controlled Trial

		Hypertension	Diabetes	Hyperlipidemia
Number of Months of Lactation		OR (95% CI)	OR (95% CI)	OR (95% CI)
<b>Adjusted for socio-demographic, family history, and lifestyle variables*</b>	<i>Never</i>	<i>Referent</i>	.	.
	<i>1-6 Months</i>	0.95 (0.92-0.98)	0.92 (0.85-0.99)	0.93 (0.89-0.97)
	<i>7-12 Months</i>	0.88 (0.84-0.91)	0.87 (0.78-0.97)	0.87 (0.82-0.93)
	<i>13-23 Months</i>	0.89 (0.84-0.93)	0.74 (0.65-0.84)	0.81 (0.76-0.87)
	<i>24+ Months</i>	0.87 (0.82-0.93)	0.89 (0.77-1.02)	0.80 (0.74-0.87)
	<b><i>P for trend</i></b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>
<b>Adjusted for above plus Body Mass Index<sup>†</sup></b>	<i>Never</i>	<i>Referent</i>	.	.
	<i>1-6 Months</i>	0.95 (0.92-0.98)	0.91 (0.84-0.99)	0.93 (0.89-0.97)
	<i>7-12 Months</i>	0.88 (0.84-0.92)	0.87 (0.78-0.97)	0.88 (0.83-0.94)
	<i>13-23 Months</i>	0.89 (0.84-0.93)	0.75 (0.66-0.85)	0.81 (0.76-0.87)
	<i>24+ Months</i>	0.87 (0.82-0.92)	0.88 (0.76-1.01)	0.80 (0.73-0.87)
	<b><i>P for trend</i></b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>

\* Specifically, age, race, parity, age at menopause, education, income, family history (of diabetes mellitus, myocardial infarction or stroke), physical activity, energy, cholesterol, fat, fiber, and sodium intakes, tobacco history, hormone replacement therapy use, aspirin use, multivitamin use.

<sup>†</sup> adjusted for 3 categories of body mass index (BMI): <25, 25 to <30, and ≥30.

**Table 4**

Association between Duration of Lactation and Cardiovascular Disease (CVD) among participants in the Womens Health Initiative Observational Study and Controlled Trial

Number of Months of Lactation		Prevalent CVD <sup>*</sup> OR (95% CI)	Incident CVD <sup>†</sup> HR (95% CI)
Univariable models	<i>Never</i>	Referent	Referent
	<i>1-6 Months</i>	1.11 (1.06-1.15)	1.08 (1.03-1.13)
	<i>7-12 Months</i>	0.94 (0.88-0.99)	0.92 (0.86-0.98)
	<i>13-23 Months</i>	0.90 (0.85-0.96)	0.93 (0.86-1.00)
	<i>24+ Months</i>	0.99 (0.92-1.07)	0.96 (0.88-1.05)
	<i>P for trend</i>	<b>0.007</b>	<b>0.01</b>
	Adjusted for socio-demographic, family history, and lifestyle variables <sup>**</sup>	<i>Never</i>	Referent
<i>1-6 Months</i>		1.03 (0.97-1.08)	1.03 (0.98-1.08)
<i>7-12 Months</i>		0.94 (0.87-1.01)	0.97 (0.90-1.03)
<i>13-23 Months</i>		0.92 (0.85-1.00)	0.98 (0.91-1.05)
<i>24+ Months</i>		0.86 (0.89-0.98)	0.93 (0.85-1.02)
<i>P for trend</i>		<b>0.003</b>	<b>0.10</b>
Adjusted for above plus Body Mass Index <sup>§</sup>		<i>Never</i>	Referent
	<i>1-6 Months</i>	1.03 (0.98-1.09)	1.03 (0.98-1.08)
	<i>7-12 Months</i>	0.95 (0.88-1.02)	0.97 (0.90-1.04)
	<i>13-23 Months</i>	0.93 (0.85-1.01)	0.98 (0.91-1.05)
	<i>24+ Months</i>	0.89 (0.80-0.98)	0.93 (0.85-1.02)
	<i>P for trend</i>	<b>0.005</b>	<b>0.12</b>

\* Cardiovascular disease on enrollment was identified by a self-reported history of myocardial infarction, angina, congestive heart failure, peripheral arterial disease, revascularization, or stroke.

<sup>†</sup> Incident cardiovascular disease (coronary heart disease, stroke, congestive heart failure, angina, peripheral vascular disease, carotid artery disease, and coronary revascularization) was validated by physician adjudication of medical records over 7.9 years of follow up.

\*\* Specifically, age, race, parity, age at menopause, education, income, family history (of diabetes mellitus, myocardial infarction or stroke), physical activity, energy, cholesterol, fat, fiber, and sodium intakes, tobacco history, hormone replacement therapy use, aspirin use, multivitamin use.

<sup>§</sup> adjusted for 3 categories of body mass index (BMI): <25, 25 to <30, and ≥30.

**Table 5**

Association between duration of lactation and prevalence of cardiovascular risk factors,\* with additional adjustment for weight at age 18, birth weight, and whether a woman was breastfed as an infant

Number of Months of Lactation		OR	95% CI	P for trend
<b>Obesity</b>	<i>Never</i>	Referent		0.67
	<i>1-6 months</i>	1.00	(0.95 - 1.05)	
	<i>7-12 Months</i>	0.94	(0.87 - 1.00)	
	<i>13-23 Months</i>	0.94	(0.87 - 1.02)	
	<i>24+ Months</i>	1.07	(0.98 - 1.18)	
<b>Hypertension</b>	<i>Never</i>	Referent		<.0001
	<i>1-6 months</i>	0.95	(0.91 - 0.99)	
	<i>7-12 Months</i>	0.87	(0.82 - 0.93)	
	<i>13-23 Months</i>	0.90	(0.85 - 0.97)	
	<i>24+ Months</i>	0.88	(0.81 - 0.95)	
<b>Diabetes</b>	<i>Never</i>	Referent		0.02
	<i>1-6 months</i>	0.94	(0.84 - 1.04)	
	<i>7-12 Months</i>	0.91	(0.78 - 1.06)	
	<i>13-23 Months</i>	0.69	(0.58 - 0.84)	
	<i>24+ Months</i>	0.99	(0.82 - 1.19)	
<b>Hyperlipidemia</b>	<i>Never</i>	Referent		<.0001
	<i>1-6 months</i>	0.91	(0.86 - 0.96)	
	<i>7-12 Months</i>	0.84	(0.78 - 0.91)	
	<i>13-23 Months</i>	0.80	(0.73 - 0.87)	
	<i>24+ Months</i>	0.83	(0.74 - 0.93)	
<b>Cardiovascular disease</b>	<i>Never</i>	Referent		0.26
	<i>1-6 months</i>	1.06	(0.99 - 1.13)	
	<i>7-12 Months</i>	0.97	(0.88 - 1.06)	
	<i>13-23 Months</i>	0.98	(0.88 - 1.09)	
	<i>24+ Months</i>	0.94	(0.82 - 1.07)	

\* These analyses include only participants in the WHI observational study (N=78825) who provided information on their weight at age 18, birth weight, and whether they were breastfed as an infant. All models are adjusted for age, race, parity, smoking, education, income, age at menopause, physical activity; diet (energy, cholesterol, fat, fiber, and sodium intakes), use of postmenopausal hormone therapy, aspirin, and, multivitamins, and family history of diabetes, myocardial infarction, or stroke, in addition to these variables.