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Prevalence and Risk Factors for Postpartum Depressive Symptoms Among Women Enrolled in WIC

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Abstract The objectives of this study were to determine the prevalence and correlates of postpartum depressive symptoms (PDS) among women with a recent live birth and specifically among women participating in and eligible for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Pregnancy Risk Assessment and Monitoring System data from 22 states in 2006–2008 (n = 75,234) were used to estimate the prevalence of PDS using a two-question screener. Associations between PDS and respondent demographics, risk factors and behaviors, and WIC program eligibility and participation were assessed using logistic regression. Overall prevalence of PDS was 13.8 %:19.8 % among WIC participants, 16.3 % among non-participants eligible for WIC, and 6.8 % of women not eligible for the program. PDS prevalence was higher among younger, less educated, and poorer women, as well as those engaging in risky behaviors during pregnancy (smoking and binge drinking), and those with an unintended pregnancy and who experienced intimate partner violence during pregnancy. Controlling for these factors, the odds of PDS were no different between WIC participants and women eligible but not participating in the program (aOR 1.08, 95 % CI 0.97–1.22), but WIC enrollees were significantly more likely than ineligible women to report PDS (aOR 1.65, 95 % CI 1.39–1.95). WIC serves more than 1 million pregnant women each year, one-fifth of whom may experience PDS. WIC has a unique opportunity to screen and provide referrals to new mothers receiving postpartum WIC benefits.

Keywords Postpartum depression · Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) · Low-income women · PRAMS

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Introduction

Postpartum depression is moderate to severe depression occurring within 12 months after the birth of a child and is estimated to occur among 10–15 % of mothers [1, 2]. Postpartum depression can significantly undermine the developing relationship between mother and baby, leading to a host of negative outcomes including poorer health-related quality of life for the child and mother [3], and delays in cognitive and language development [4, 5]. Research has found that even subclinical levels of depressive symptoms in the first year postpartum can have negative effects on maternal and child health outcomes. Specifically, postpartum depressive symptoms (PDS)—including sad or depressed mood, little interest in doing things, fatigue, and anxiety—have been associated with lower rates of breastfeeding initiation and shorter duration[6], as well as poorer infant weight gain [7, 8], childhood overweight and adiposity [9].

Several risk factors for PDS have been identified, including prior history of depression, stressful life events, including financial stress [10–12], low social support, intimate partner violence (IPV) [10, 13], and unintended pregnancy [12–15]. Poor women are more likely to

experience many of these risk factors and low-income status has consistently been associated with higher rates of PDS [7, 13, 14, 16]. Research has shown that up to 50 % of low-income women may suffer from postpartum depression [11, 17]. Women experiencing PDS may also be more likely to have lower educational attainment [10], more likely to be a racial/ethnic minority [10, 18], of a younger age [10, 16, 18], and have had a previous birth [12, 16].

Additional risk factors for PDS include loss of employment and homelessness [13], and having had a preterm birth [19, 20]. Risky maternal behaviors, including binge drinking [19, 21] and smoking during pregnancy [10, 11], have also been associated with higher likelihood of PDS. For instance, Boury et al. [11] reported that cigarette smoking accounted for nearly half of the variance in rates of PDS for low-income mothers enrolled in WIC.

Postpartum depression is often unrecognized and untreated, despite well-documented risk factors [11, 14], evidence-based screening tools [22], and recommendations by professional organizations that women be screened for postpartum depression [23, 24]. Multiple barriers to screening exist in obstetrical and pediatric practices, such as time constraints, inadequate training related to depression treatment, and lack of effective referral mechanisms [22]. As a result, approximately half of women with postpartum depression do not receive any form of mental health evaluation or treatment [25]. Low-income women are at even greater risk for having their depression overlooked, in part, due to lack of knowledge about depression, logistic and financial barriers, stigma, and fear of child protective services involvement [26, 27]. Integrating routine depression screening into non-primary care settings where low-income women are receiving services during the postpartum period may help to fill this gap, and improve access to community mental health services.

The WIC Program is one such setting that could potentially address this need through collaboration and coordination with local, community mental health providers and services. WIC serves more than half of all infants born in the U.S. and nearly 70 % of low-income pregnant and postpartum women [28]. As such, WIC has unparalleled reach into populations of low-income pregnant and postpartum women. This study was intended to:

1. Document the prevalence of PDS in women participating in WIC compared with other women; and
2. Identify specific risk factors associated with elevated rates of PDS.

Additionally, we sought to compare PDS prevalence between WIC participants and another low-income population of women: those eligible for, but not participating in WIC. The prevalence of risk factors among WIC participants may differ from those who are income eligible but not enrolled. Since these characteristics may also be associated with PDS, we wanted to test this hypothesis and examine the prevalence of PDS and these risk factors between the two groups.

Methods

Data Source

We conducted a secondary analysis of the Pregnancy Risk Assessment Monitoring System (PRAMS), a collaborative effort of the Centers for Disease Control and Prevention (CDC) and state health departments [29]. PRAMS data are collected annually by individual states and reported to CDC. Sample weights are calculated by CDC and applied to aggregated data from all states to provide nationally-representative estimates. PRAMS data are matched with state birth certificate data, providing a wealth of micro-data on indicators related to pregnancy, birth outcomes, and maternal experiences. States mail the PRAMS questionnaire in English and Spanish to a stratified sample of new mothers (identified through vital records) approximately 2–6 months postpartum. Non-responders are followed-up via telephone and interviewed as available. Surveys consist of core questions common to all states, and standard questions chosen from a pretested list developed by the CDC or by state health departments. This study presents data from states meeting CDC's required minimum overall response rate of 70 % in 2006, and 65 % in 2007–2008.

Data were available for 78,701 respondents. Data for selected respondents were excluded. Specifically, women whose WIC participation or eligibility could not be determined (n = 1,708) were excluded, as this was the primary group of interest. Women whose infants were not reported to be alive at the time of the survey were excluded (n = 1,217) so that grieving for the loss of a child does not erroneously inflate the proportion of women showing symptoms of postpartum depression. Additionally, women whose infants were not reported to be residing with them at the time of the survey (n = 542) were excluded. Overall, 4.4 % of respondents were excluded. The final analytic sample included 75,234 new mothers in 2006–2008 across 22 states.

Measures

Dependent Variables

In 2006–2008, 22 states[1] fielded 2 standard questions from the Patient Health Questionnaire (PHQ-2) [30] depression

[1] States included in the analyses: Alaska, Colorado, Delaware, Georgia, Hawaii, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New York, North Carolina, Ohio, Oregon, Rhode Island, South Carolina, Tennessee, Utah, Washington, Wisconsin, and Wyoming.

screening tool that were used for this analysis. "Since your new baby was born, how often have you felt down, depressed, or hopeless?" and "Since your new baby was born, how often have you had little interest or little pleasure in doing things?" Responses ranged from "never" to "always" on a 5-point likert-type scale. A woman was classified as having PDS if she responded "always" or "often" to either or both of these questions. Since the diagnostic criteria for clinically significant depression requires endorsement of either depressed mood or anhedonia, this approach is consistent with similar studies [10, 15, 18].

Independent Variables

The primary independent variable of interest was WIC status, including participation and eligibility. Since WIC participants may differ significantly from their eligible counterparts on many characteristics and risk factors previously associated with PDS, we created a three-category variable to reflect WIC participation and eligibility status. WIC participants were identified through the PRAMS questionnaire or the birth certificate, in the event that a response was not provided on the former. Women who would have been eligible for (but were not enrolled in) WIC were identified if they reported that they did not participate in WIC during pregnancy and had at least one of the following three characteristics: household income of less than 185 % of poverty in the 12 months prior to delivery, Medicaid participation during pregnancy, or receipt of Temporary Assistance for Needy Families (TANF) or Food Stamps in the 12 months prior to delivery. Income as a percent of poverty, or poverty level, was calculated by comparing the reported annual household income and number of persons in the household to U.S. Department of Health and Human Services poverty guidelines for 2006–2008 [31], which provides a set dollar amount per person as the basis for determining federal program income eligibility. Since PRAMS only collects categorical income values (e.g., $20,000 to $24,999), the mid-values for the categories were used to represent household income; this method is commonly used in analyses of PRAMS and BRFSS data that do not ask for an exact income value [32]. Because pregnant women are adjunctively eligible for WIC if they participate in other Federal programs, women who reported Medicaid as the method of payment for prenatal care or delivery in the PRAMS questionnaire or as the payment method for delivery on the birth certificate were considered WIC-eligible as were those who reported receipt of TANF or Food Stamps on the PRAMS survey.

Demographic characteristics of interest included maternal race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic American Indian/Alaska Native, Native Hawaiian,[2] non-Hispanic other Asian and Pacific Islander, non-Hispanic multiple races, and non-Hispanic other races), age at delivery (<20 years of age, 20–24 years, and ≥25 years), educational attainment (<high school, high school diploma, some college, and college degree or higher), and parity.

Risk factors for postpartum depression included pregnancy intendedness, IPV during pregnancy, and two factors related to financial stress: job loss and homelessness in the 12 months prior to delivery. A pregnancy was considered intended if the mother reported wanting the pregnancy then or sooner; if the mother indicated that the pregnancy was mistimed (wanted to be pregnant later) or unwanted, then it was categorized as unintended. Exposure to IPV during pregnancy was captured using two questions about whether the woman was physically hurt by a former or current husband or partner during the pregnancy. An affirmative response to either question was coded as having been exposed to IPV during pregnancy. Job loss and homelessness during pregnancy were ascertained from a single question on multiple stress factors during pregnancy; responses were binary. Preterm birth was also included as a potential predictor of PDS and was defined as a birth prior to 37 weeks gestation, based on gestational age recorded on the birth certificate.

Risky maternal behaviors included binge drinking and smoking during pregnancy. Binge drinkers were identified as those reporting 5 or more alcoholic drinks in one sitting during the last 3 months of pregnancy. Smoking status was calculated as a three-category variable: no smoking prior or during pregnancy; prior smoking but no smoking in the last trimester (quit smoking); and both prior and ongoing smoking in the last trimester.

Analysis

We calculated the prevalence of PDS overall and among women by WIC participation and eligibility. Bivariate associations between independent variables of interest and both WIC status (participation and eligibility) and PDS were calculated; statistical significance was set at $p < 0.01$. Three multiple logistic regression models were estimated to further examine the associations between PDS and maternal characteristics, risk factors and risky behaviors, and WIC program participation and eligibility. We used an empirical approach to specifying three logistic regression models. Model 1 included all demographic characteristics that were significantly associated with PDS in bivariate

[2] Due to differences in how states collect and report racial and ethnic data to CDC PRAMS, the race groups used in this paper in some cases include persons of multiple races and of Hispanic origin. Where possible, however, race groups were categorized as mutually exclusive.

analyses. Model 2 retained all significant demographic characteristics from Model 1, and added risk factors and risky behaviors found to be associated with PDS in bivariate analyses. Model 3 retained all previously significant predictors of PDS, and added the 3-category WIC participation and eligibility variable. All analyses were conducted using SAS version 9.2 (SAS Institute, Cary, NC, USA) and SAS-callable SUDAAN version 10 (Research Triangle Institute, Research Triangle Park, NC, USA).

Results

Consistent with prevalence rates for the general population, 13.8 % of PRAMS respondents experienced PDS in 2006–2008. This varied by WIC participation and eligibility: nearly 20 % of women who participated in WIC reported PDS compared to 16.3 % of eligible, but non-participating women, and 6.8 % of ineligible respondents (Table 1). As expected, WIC enrollees differed from their eligible, but non-participating, and ineligible counterparts on several socio-demographic and health-related characteristics, including maternal age, maternal education, poverty status, cigarette smoking, obesity, IPV, pregnancy intendedness, and past-year unemployment and homelessness. Nearly one-fifth of WIC participants were younger than 20 years of age, compared to 10.3 % of eligible but non-participating women, and nearly one-third had less than a high-school education compared to 20.2 % of their non-participating, but eligible, counterparts. Over half of program participants lived in households with incomes below poverty—a rate twice that of the PRAMS population overall (28.3 %). Nearly 6 % of WIC participants reported that they had experienced violence at the hands of a current or former partner during their pregnancy compared to 4.0 % of other eligible women and less than 1 % of ineligible women. While rates of perinatal binge drinking were similar across eligibility and program groups, WIC participants were significantly more likely to report ongoing cigarette use during the last trimester (18.9 %) compared to 14.6 % of eligible non-participants and 4.4 % of ineligible respondents (Table 1).

Bivariate associations between selected risk factors and PDS by WIC eligibility and participation are presented in Table 2. The results suggest that while many PDS risk factors were similar for women across eligibility and program groups, the magnitude, strength, and pattern of those associations varied. For example, while the proportion of eligible mothers who reported PDS was similar among those with less than a high-school education (22.3 % among both WIC participants and non-participants), over 15 % of college-educated WIC mothers reported PDS—nearly two times the rate reported by program non-participants with the same level of educational attainment. Similarly, while nearly one-quarter of all mothers who smoked during their last trimester reported PDS, nearly 18 % of WIC mothers who did not smoke prior to pregnancy reported PDS, compared to 13.5 % of eligible, but not participating mothers. While lower levels of cigarette use and higher levels of education were associated with lower rates of PPD symptomology for both populations, WIC mothers remained at higher risk than their non-participating but eligible counterparts.

Several risk factors, including IPV, past-year homelessness and unemployment, were associated with higher rates of PDS among all eligible women. Over one-third of WIC-eligible mothers who had experienced IPV during their pregnancy reported PDS. Among women in all WIC participation/eligibility categories, rates of PDS among those exposed to IPV were between two and three times greater than for mothers who reported they did not experience IPV. Similarly, having lost a job or having been homeless in the 12 months prior to the birth of their last child was associated with higher rates of PDS. Nearly 30 % of WIC participants who experienced either of these events reported PDS while the same was true for about one-quarter of eligible women who did not participate in WIC. PDS rates among women who did not experience homelessness or unemployment were about 10-percentage points lower for both outcomes in both eligible populations.

Multivariate logistic regression results are presented in Table 3. As illustrated in Model 1, the odds of reported PDS varied by race/ethnicity, maternal age and education, and poverty status, with those who are younger, less educated, and living in poverty at greater risk for symptoms. Of note, after controlling for these socio-demographic risk factors, Hispanic women had lower odds of reporting PDS compared to non-Hispanic White women while all other racial and ethnic groups (with the exception of Native Hawaiian women) were at increased risk for reported symptoms.

Maternal age was no longer independently associated with reported PDS after adjustment for other PDS risk factors and risky behaviors in Model 2, and the association between PDS and poverty status was somewhat attenuated: the odds of PDS among women living in poverty declined from 2.17 (95 % CI 1.94–2.43) to 1.67 (95 % CI 1.48–1.89). The results for Hispanic and American Indian/Alaska Native women were no longer statistically significant, however, non-Hispanic Black and Asian women, as well as women of multiple races and other non-White women remained 1.3 to 2.2 times more likely to report symptoms compared to non-Hispanic White women. Of the health and social risk factors and behaviors included in Model 2, the strongest association with PDS was observed for binge drinking at least once during the final trimester (aOR 2.01, 95 % CI 1.35–2.99), followed by IPV (aOR

Table 1 Maternal characteristics and risk factors, by WIC participation and eligibility, PRAMS 2006–2008

	Total			Eligible women						Ineligible women		
				WIC participants			Non-participants					
	N	%	SE	N	%	SE	N	%	SE	N	%	SE
Postpartum depressive symptoms	75,234			33,502			11,483			30,249		
Yes	11,001	13.8	0.22	6,680	19.8	0.41	1,938	16.3	0.63	2,383	6.8	0.22
No	64,233	86.2	0.22	26,822	80.2	0.41	9,545	83.7	0.63	27,866	93.2	0.22
Demographic characteristics												
Race/ethnicity	72,289			31,870			11,038			29,381		
NH white	38,358	65.7	0.26	11,352	47.7	0.47	5,575	62.3	0.79	21,431	84.4	0.30
NH black	10,126	12.9	0.21	6,793	21.2	0.41	1,631	14.3	0.63	1,702	4.4	0.19
Hispanic	11,526	13.8	0.19	8,141	23.4	0.38	1,877	15.3	0.57	1,508	4.0	0.16
NH American Indian/Alaska Native	3,294	0.9	0.03	2,255	1.4	0.06	529	1.0	0.10	510	0.4	0.03
Native Hawaiian	860	0.4	0.01	490	0.6	0.02	170	0.5	0.04	200	0.2	0.02
NH other Asian/Pacific Islander	6,468	4.4	0.11	1,984	3.4	0.16	990	4.6	0.30	3,494	5.4	0.17
NH multiple races	1,247	1.1	0.08	635	1.4	0.15	206	1.3	0.25	406	0.8	0.09
NH other races	410	0.7	0.05	220	0.9	0.10	60	0.6	0.14	130	0.5	0.06
Maternal age group	75,231			33,500			11,482			30,249		
Less than 20 years	7,048	9.6	0.20	5,688	18.3	0.41	1,180	10.3	0.53	180	0.7	0.09
20–24 years	17,537	23.4	0.27	11,510	35.6	0.48	3,454	30.2	0.76	2,573	8.5	0.27
25 years and older	50,646	67.0	0.30	16,302	46.1	0.50	6,848	59.5	0.82	27,496	90.8	0.28
Maternal education	73,989			32,820			11,251			29,918		
Less than high school	12,244	16.4	0.25	9,654	30.2	0.47	2,209	20.2	0.72	381	1.3	0.12
High school diploma	20,835	27.8	0.29	12,888	40.3	0.50	3,937	34.6	0.81	4,010	12.9	0.32
Some college	18,693	24.7	0.27	7,815	22.7	0.41	3,371	29.4	0.75	7,507	25.1	0.40
College degree or more	22,217	31.1	0.28	2,463	6.8	0.23	1,734	15.8	0.59	18,020	60.7	0.45
Poverty status	70,841			29,910			10,682			30,249		
Less than 100 % of poverty	21,376	28.3	0.29	17,015	56.2	0.52	4,361	38.2	0.83	–		
100–185 % of poverty	13,122	18.5	0.26	8,301	28.9	0.48	4,821	46.7	0.85	–		
More than 185 % of poverty	36,343	53.2	0.32	4,594	14.9	0.36	1,500	15.1	0.61	30,249	100.00	0.00
Previous birth	74,734			33,241			11,399			30,094		
Yes	43,216	58.5	0.31	19,453	58.5	0.50	7,248	64.7	0.80	16,515	56.3	0.45
No	31,518	41.5	0.31	13,788	41.5	0.50	4,151	35.3	0.80	13,579	43.7	0.45
Risk factors												
Preterm birth	74,389			32,999			11,328			30,062		
Yes	15,850	8.6	0.14	7,230	9.0	0.23	2,534	8.9	0.37	6,086	7.9	0.21
No	58,539	91.4	0.14	25,769	91.0	0.23	8,794	91.1	0.37	23,976	92.1	0.21
Pregnancy intention	74,005			32,871			11,252			29,882		
Unintended	30,182	40.8	0.31	17,811	55.8	0.50	5,829	52.5	0.84	6,542	21.5	0.38
Intended	43,823	59.2	0.31	15,060	44.2	0.50	5,423	47.5	0.84	23,340	78.5	0.38
IPV during pregnancy	74,206			32,766			11,333			30,107		
Yes	2,668	3.4	0.12	1,950	5.8	0.24	480	4.0	0.36	238	0.7	0.08
No	71,538	96.6	0.12	30,816	94.2	0.24	10,853	96.0	0.36	29,869	99.3	0.08
Lost job, 12 mo prior to birth	74,208			32,868			11,284			30,056		
Yes	7,256	9.3	0.19	5,177	15.5	0.37	1,277	10.9	0.51	802	2.5	0.14
No	66,952	90.7	0.19	27,691	84.5	0.37	10,007	89.1	0.51	29,254	97.5	0.14
Homeless, 12 mo prior to birth	74,320			32,945			11,304			30,071		
Yes	2,887	3.5	0.11	2,301	6.5	0.23	527	4.5	0.35	59	0.1	0.03
No	71,433	96.5	0.11	30,644	93.5	0.23	10,777	95.5	0.35	30,012	99.9	0.03

Table 1 continued

	Total			Eligible women						Ineligible women		
				WIC participants			Non-participants					
	N	%	SE	N	%	SE	N	%	SE	N	%	SE
Maternal health risk behaviors												
Smoking, last trimester	74,285			32,955			11,324			30,006		
Did not quit (smoked)	9,235	12.1	0.21	6,060	18.9	0.39	1,895	14.6	0.57	1,280	4.4	0.20
Quit during pregnancy	7,274	10.1	0.19	3,756	11.4	0.32	1,264	11.4	0.53	2,254	8.3	0.27
Did not smoke	57,776	77.8	0.27	23,139	69.7	0.46	8,165	74.0	0.72	26,472	87.3	0.32
Binge drinking, last trimester	74,028			32,934			11,305			29,789		
Yes	532	0.7	0.06	316	0.8	0.10	85	0.7	0.14	131	0.5	0.07
No	73,496	99.3	0.06	32,618	99.2	0.10	11,220	99.3	0.14	29,658	99.5	0.07
WIC eligibility												
WIC Participant	33,502	42.8	0.31									
Eligible, non-participant	11,483	15.0	0.23									
Ineligible	30,249	42.2	0.30									

Table 2 Characteristics and risk factors of women reporting PDS, by WIC participation and eligibility, PRAMS 2006–2008

	Total			WIC eligible						Ineligible		
				WIC participant			Non-participant					
	N	% (SE)	*p*	N	% (SE)	*p*	N	% (SE)	*p*	N	% (SE)	*p*
Demographic characteristics												
Race/ethnicity												
NH white	4,526	11.6 (0.26)	*	2,266	20.1 (0.61)	*	812	14.6 (0.75)	#	1,448	6.2 (0.24)	*
NH black	2,067	20.3 (0.78)		1,571	23.2 (1.01)		318	15.7 (1.53)		178	11.7 (1.54)	
Hispanic	1,795	14.9 (0.56)		1,344	15.8 (0.69)		314	16.9 (1.54)		137	7.1 (0.86)	
NH American Indian/Alaska Native	616	21.3 (1.60)		453	22.7 (1.90)		113	29.3 (4.97)		50	7.4 (1.60)	
Native Hawaiian	145	16.1 (1.23)		96	18.7 (1.73)		31	18.2 (2.89)		18	7.9 (1.79)	
NH other Asian/ Pacific Islander	1,070	17.3 (0.91)		440	22.4 (1.80)		211	23.8 (2.92)		419	12.3 (1.00)	
NH multiple races	216	23.9 (3.27)		122	23.4 (4.92)		41	29.2 (8.01)		53	21.7 (4.99)	
NH other races	86	22.6 (3.66)		50	24.9 (5.37)		NR	NR		24	16.7 (3.82)	
Maternal age group												
Less than 20 years	1,536	21.7 (0.93)	*	1,274	21.9 (1.03)	#	232	22.5 (2.45)	#	30	11.9 (3.29)	†
20–24 years	3,176	18.2 (0.54)		2,313	20.6 (0.71)		624	17.6 (1.12)		239	8.6 (0.91)	
25 years and older	6,289	11.2 (0.24)		3,093	18.5 (0.55)		1,082	14.7 (0.79)		2,114	6.6 (0.22)	
Maternal education												
Less than high school	2,606	21.8 (0.72)	*	2,086	22.3 (0.82)	*	472	22.3 (1.74)	*	48	9.2 (2.06)	*
High school diploma	3,676	17.4 (0.48)		2,580	20.0 (0.66)		695	17.0 (1.10)		401	9.4 (0.75)	
Some college	2,699	13.2 (0.42)		1,471	17.7 (0.76)		549	15.3 (1.05)		679	8.4 (0.50)	
College degree or more	1,792	6.8 (0.26)		385	15.5 (1.27)		179	8.8 (1.17)		1,228	5.6 (0.25)	

Table 2 continued

	Total			WIC eligible						Ineligible		
				WIC participant			Non-participant					
	N	% (SE)	*p*	N	% (SE)	*p*	N	% (SE)	*p*	N	% (SE)	*p*
Poverty status												
Less than 100 % of poverty	4,800	22.7 (0.54)	*	3,875	22.9 (0.61)	*	925	21.9 (1.16)	*	–		
100–185 % of poverty	2,097	15.4 (0.57)		1,420	16.8 (0.75)		677	13.0 (0.87)		–		
More than 185 % of poverty	3,304	8.1 (0.23)		717	15.2 (0.92)		204	15.0 (1.73)		2,383	6.8 (0.22)	
Previous birth												
Yes	6,621	14.5 (0.30)	^	4,022	21.0 (0.55)	^	1,264	16.4 (0.79)		1,335	6.9 (0.29)	
No	4,299	12.8 (0.33)		2,603	18.1 (0.60)		659	16.0 (1.04)		1,037	6.8 (0.34)	
Risk factors												
Preterm birth												
Yes	2,788	17.4 (0.63)	*	1,670	23.2 (1.06)	#	540	22.9 (1.80)	^	578	8.5 (0.69)	†
No	8,085	13.5 (0.24)		4,913	19.5 (0.44)		1,379	15.7 (0.67)		1,793	6.7 (0.23)	
Pregnancy intention												
Unintended	5,833	19.2 (0.42)	*	3,961	22.7 (0.59)	*	1,176	20.1 (0.97)	*	696	9.1 (0.56)	*
Intended	4,964	10.1 (0.24)		2,581	16.0 (0.54)		725	12.4 (0.80)		1,658	6.2 (0.23)	
IPV during pregnancy												
Yes	967	35.8 (1.77)	*	731	36.5 (2.05)	*	177	42.2 (4.61)	*	59	15.8 (3.14)	#
No	9,830	13.0 (0.22)		5,795	18.9 (0.42)		1,725	15.2 (0.62)		2,310	6.8 (0.22)	
Lost job, 12 mo prior to birth												
Yes	1,886	25.9 (0.97)	*	1,411	27.9 (1.21)	*	357	26.2 (2.21)	*	118	13.4 (1.82)	^
No	8,924	12.6 (0.23)		5,124	18.5 (0.43)		1,549	15.2 (0.66)		2,251	6.7 (0.22)	
Homeless, 12 mo prior to birth												
Yes	863	29.8 (1.52)	*	690	30.4 (1.70)	*	162	27.4 (3.55)	#	NR	NR	
No	9,972	13.3 (0.23)		5,870	19.2 (0.43)		1,743	15.9 (0.65)		2,359	6.8 (0.22)	
Maternal health risk behaviors												
Smoking, last trimester												
Did not quit (smoked)	2,174	24.3 (0.82)	*	1,536	25.7 (1.03)	*	465	28.9 (2.02)	*	173	13.1 (1.55)	*
Quit during pregnancy	1,227	17.1 (0.79)		776	21.8 (1.27)		229	18.8 (2.07)		222	9.8 (0.95)	
Did not smoke	7,409	11.7 (0.23)		4,233	17.8 (0.47)		1,216	13.5 (0.67)		1,960	6.2 (0.22)	
Binge drinking, 3rd trimester												
Yes	141	31.4 (4.20)	^	103	44.8 (6.12)	#	NR	NR		NR	NR	
No	10,658	13.7 (0.22)		6,453	19.7 (0.41)		1,877	16.3 (0.64)		2,328	6.8 (0.22)	

NR Not reported due to relative standard error >30 %

* $p < 0.0001$, ^ $p < 0.001$, # $p < 0.01$, † $p < 0.05$

1.89, 95 % CI 1.59–2.24) and continued cigarette smoking (aOR 1.65, 95 % CI 1.46–1.85).

Model 3 presents results for the final model which controlled for WIC participation and eligibility. After controlling for program participation, the increased risk observed for non-Hispanic Blacks and Asians, as well as women of multiple races and other non-White races remained. In contrast, Hispanics had marginally lower odds of reporting symptoms (aOR 0.85, 95 % CI 0.74–0.98). The results for maternal education were further attenuated in this model. Otherwise, the strongest independent associations continued to be observed for third trimester binge drinking, IPV, and cigarette smoking, aORs 2.4 (95 % CI 1.37–3.02), 1.89 (95 % CI 1.59–2.25), and 1.59 (95 % CI 1.42–1.79), respectively. Controlling for all other socio-demographic and health-related risk factors, women who participated in WIC were 65 % more likely to report PDS than women who were not eligible to participate in the program, while non-participating eligible women were 52 % more likely to report PDS. Sub-analyses limited to eligible women indicated that the odds of PDS were not statistically different between participants and non-

Table 3 Odds of PDS among all women

	Model 1			Model 2			Model 3		
	Demographic characteristics			Including risk factors			Including WIC eligibility		
	OR	95 % CI	Wald *p* value	OR	95 % CI	Wald *p* value	OR	95 % CI	Wald *p* value
Demographic characteristics									
Race/ethnicity									
NH white	REF	REF	<0.0001	REF	REF	<0.0001	REF	REF	<0.0001
NH black	1.33	1.19,1.50		1.33	1.17,1.51		1.27	1.12,1.44	
Hispanic	0.76	0.67,0.86		0.89	0.78,1.02		0.85	0.74,0.98	
NH American Indian/Alaska Native	1.27	1.03,1.56		1.26	1.00,1.58		1.22	0.97,1.54	
Native Hawaiian	1.10	0.91,1.33		1.08	0.89,1.33		1.06	0.86,1.30	
NH other Asian/Pacific Islander	1.78	1.54,2.06		1.98	1.70,2.32		1.93	1.66,2.25	
NH multiple races	2.07	1.44,2.98		2.02	1.39,2.94		2.00	1.37,2.90	
NH other races	2.02	1.31.3.11		2.21	1.37,3.57		2.14	1.33,3.44	
Maternal age group									
Less than 20 years	1.24	1.06,1.45	0.0018	1.19	1.01,1.41	0.0944			–
20–24 years	1.18	1.07,1.31		1.08	0.97,1.20				
25 years and older	REF	REF		REF	REF				
Maternal education									
Less than high school	2.16	1.84,2.54	<0.0001	1.78	1.50,2.11	<0.0001	1.69	1.44,1.99	<0.0001
High school diploma	1.77	1.56,2.01		1.57	1.37,1.78		1.47	1.29,1.67	
Some college	1.61	1.43,1.80		1.43	1.27,1.62		1.35	1.19,1.53	
College degree or more	REF	REF		REF	REF		REF	REF	
Poverty status									
Less than 100 % of poverty	2.17	1.94,2.43	<0.0001	1.67	1.48,1.89	<0.0001	1.27	1.08,1.48	<0.0001
100–185 % of poverty	1.47	1.31,1.64		1.28	1.14,1.45		0.95	0.81,1.12	
More than 185 % of poverty	REF	REF		REF	REF		REF	REF	
Previous Birth									
Yes	1.20	1.09,1.31	0.0001	1.20	1.09,1.31	0.0002	1.16	1.06,1.26	0.0006
No	REF	REF		REF	REF		REF	REF	
Risk factors									
Preterm birth									
Yes				1.29	1.15,1.44	<0.0001	1.29	1.15,1.44	<0.0001
No				REF	REF		REF	REF	
Pregnancy intention									
Unintended				1.37	1.26,1.50	<0.0001	1.37	1.25,1.49	<0.0001
Intended				REF	REF		REF	REF	
IPV during pregnancy									
Yes				1.89	1.59,2.24	<0.0001	1.89	1.59,2.25	<0.0001
No				REF	REF		REF	REF	
Lost job, 12 mo prior to birth									
Yes				1.58	1.40,1.78	<0.0001	1.53	1.36,1.73	<0.0001
No				REF	REF		REF	REF	
Homeless, 12 mo prior to birth									
Yes				1.50	1.26,1.79	<0.0001	1.49	1.25,1.78	<0.0001
No				REF	REF		REF	REF	

Table 3 continued

	Model 1			Model 2			Model 3		
	Demographic characteristics			Including risk factors			Including WIC eligibility		
	OR	95 % CI	Wald *p* value	OR	95 % CI	Wald *p* value	OR	95 % CI	Wald *p* value
Maternal health risk behaviors									
Smoking, last trimester									
Did not quit (smoked)				1.65	1.46,1.85	<0.0001	1.59	1.42,1.79	<0.0001
Quit during pregnancy				1.32	1.16,1.50		1.30	1.14,1.48	
Did not smoke				REF	REF		REF	REF	
Binge drinking, last trimester									
Yes				2.01	1.35,2.99	0.0006	2.04	1.37,3.02	0.0004
No				REF	REF		REF	REF	
WIC eligibility									
WIC participant							1.65	1.39,1.95	<0.0001
Eligible, non-participant							1.52	1.26,1.83	
Ineligible							REF	REF	

participants (aOR 1.08, 95 % CI 0.97–1.22; data available upon request).

Discussion

While numerous studies have identified poverty status or household income as risk factors for PDS [16–18], to our knowledge, this is the first study to focus specifically on the disparities in PDS prevalence among women participating in WIC, women eligible, but not participating, and those ineligible for the program. The findings in this study indicate that WIC participants are at significantly higher risk for PDS than ineligible women. Also of interest was the higher prevalence of multiple risk factors among women enrolled in WIC versus those who were eligible, but not enrolled, which underscores the critical role that WIC can play in providing referrals for medical and social services for women at highest risk for poorer birth and nutritional outcomes.

Our results confirm a number of previous studies' findings on positive associations between certain risk factors and PDS, including: lower levels of maternal education [10], cigarette smoking status [10], and stressful life events, such as unintended pregnancy [13, 14], and loss of employment or homelessness prior to the birth of the infant [13]. Similar to other studies, we found the most important predictors of PDS to be binge drinking in the last 3 months of pregnancy [33] and experiencing IPV during pregnancy [10, 13] which increased the odds of PDS by 104 and 89 %, respectively. The WIC program already asks clients about many of these risk factors at enrollment, which may make it easier to identify those mothers at increased risk for PDS.

Our focus on WIC enrollees highlights the heightened risks that these women face, as well as the opportunities that WIC programs have to integrate screening for PDS into their routine intake and monitoring. Compared to other health and social service providers, WIC is uniquely well-positioned to play a significant role in reducing disparities in early identification of PDS in low-income women in the U.S. for a number of reasons. First, the program enrolls women during pregnancy and mothers continue to receive WIC benefits for up to 12 months postpartum. Second, WIC is positioned within communities and neighborhoods, and may have the opportunity to collaborate with community programs and mental health supports to develop and implement an appropriate screening and referral process. WIC could potentially screen women multiple times ante- and post-partum by integrating the PHQ-2 and/or PHQ-9 or other validated depression screener. Particularly, doing so in areas where mental health services are available and accessible to low-income women would allow WIC to provide appropriate referrals to women in need of additional mental health screening and treatment. This has already been successfully demonstrated in a handful of WIC clinics, such as the Contra Costa County WIC program in California [34].

Third, because WIC's primary aim is to assess and address the nutritional needs of low-income families, participants may be more accepting of PDS screening as part of a package of services rather than as the focus of inquiry in a mental health service setting. Because participants often access services over a period of months, if not years, they may feel more comfortable sharing information about their emotional state in relation to life-stressors and infant-rearing in a known setting with familiar providers. Further,

implementation of PDS and mental health screening in WIC service sites is consistent with the larger movement to integrate mental health screening and services into primary care [35].

Referring women experiencing PDS to appropriate health care services aligns closely with WIC's mission "to safeguard the health of low-income women, infants, and children up to age 5 who are at nutrition risk by providing nutritious foods to supplement diets, information on healthy eating, and referrals to health care" [36]. In addition to improving health and developmental outcomes for infants and children, early referral and treatment for perinatal depression may increase initiation and duration of breastfeeding [6], thus aiding new mothers in successfully breastfeeding infants, which has lasting benefits beyond improved infant nutrition.

This study has several limitations. All data were retrospectively self-reported by women 2–9 months postpartum. This approach introduces the possibility of both recall and reporting bias as a result of respondents being either unable or unwilling to report engaging in or exposure to risk factors [37]. For example, it is possible that women, particularly those who did not experience PDS may not recall a particular exposure, while those with depressive symptoms may be more attuned to particular experiences. In addition, respondents may be unwilling to admit engaging in risk behaviors, (i.e., perinatal tobacco or alcohol use), widely known to be associated with poor birth outcomes, because of related stigma or perceptions.

A second limitation is that we do not have information on clinical diagnosis of postpartum depression, but instead self-reported PDS. Therefore, we do not know what percentage of women reporting PDS might have been diagnosed with postpartum depression. Research has shown that the PHQ-2 (the 2 question depression scale embedded in the PRAMS) has excellent sensitivity and specificity (83 and 90 %, respectively) [30]. Other studies have demonstrated the PHQ-2's utility in detecting postpartum depression when incorporated into pediatric well-child visits [38] with equally high sensitivity. In a large national survey, the PHQ-2 offers a good snapshot of maternal distress in the postpartum period. Additionally, PRAMS does not collect information on all possible correlates of postpartum depression, such as a history of depression, so we are unable to account for those influences.

A third limitation relates to classification of WIC eligibility: "eligible, but not participating" respondents were identified, in part, based on income reported according to pre-determined categories, which may miscategorize some respondents' poverty status. In this study, we used a combination of these poverty estimates in conjunction with participation in other Federal programs (i.e., in Medicaid or SNAP) to identify the comparison group of eligible, but non-participating women. This strategy resulted in a coverage rate of about 74 % for WIC participation, which is higher than the 68.4 % in 2008 estimated by the U.S.D.A. Food and Nutrition Service [39]. Finally, the cross-sectional nature of the data do not permit us to identify temporal patterns between exposures and PDS; only associations between risk factors and the outcome of interest are presented.

Despite these limitations, however, our findings are similar to other studies reporting estimates of PDS prevalence in the general population [1, 2, 10] and among low-income populations, specifically [11, 13]. Our study also utilizes a large, population-based sample which allows us to identify independent factors associated with PDS among women, based on their WIC participation and eligibility. These data underscore the importance for WIC programs to consider embedding a brief depression screening tool into their routine practice, while collaborating with local, community-based mental health services to provide appropriate referrals and treatment to women identified with depressive symptoms. Since the WIC program serves mothers at higher risk for PDS, the program could play a critical role in reducing disparities in access to mental health treatment services for roughly half of women giving birth in the U.S.

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