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Seasonal Effects on Depression Risk and Suicidal Symptoms in Postpartum Women

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Abstract

Background—Postpartum depression (PPD) is the most common complication of childbirth. Suicide is a leading cause of maternal death in the first postpartum year. Depressed mothers often have suicidal ideation (SI). Depression and suicidality may vary across the seasons. Previous studies of seasonality and PPD were relatively small or encumbered by study design constraints. We examined the possible relationship between seasonality, depression, and SI in 9,339 new mothers.

Methods—From 2006 to 2010, the investigators screened women within 4–6 weeks postpartum with the Edinburgh Postnatal Depression Scale (EPDS). We used spectral analysis to explore seasonal variation in risk for depression and suicidality.

Results—The study team screened 9,339 new mothers, of whom 1,316 (14%) women had positive depression scores (EPDS ≥ 10) which suggest PPD risk; 294 (3%) women had SI (item 10 ≥ 1). A positive EPDS was associated significantly with SI. PPD risk varied significantly across 12-months—risk was highest in December. We detected no seasonal variation in SI.

Conclusions—Effects of seasonal light variation may contribute to increased risk for depressive symptoms. Suicidality could be related to maternal depression but not seasonal variation.

Keywords

seasonal variation; depression risk; suicidality; postpartum

Introduction

Postpartum depression (PPD) is the most common complication of childbirth. As many as 14.5% of new mothers develop major or mild depression in the first 3 months postpartum.[1] Episodes of PPD can last for 7 months or longer in 25–50% of patients.[2] Lasting

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depressive episodes are related to maternal problems with infant attachment, low income, low educational achievement (finish high school only), and single parenthood.

The relationship between depressive disorders and altered serotonin (5HT) neurotransmission[3] could extend to depressed mothers after childbirth. Women with PPD respond to treatment with serotonergic agents such as sertraline (and equally well to the noradrenergic agent nortriptyline).[4] The reduction in 5HT 1A receptor binding by 20–28% in depressed mothers compared to nondepressed postpartum controls[5] suggests that depressed patients after delivery may have lowered serotonergic tone. Altered neurotransmitter activity may be related to the postpartum milieu.[6]

Depression, suicide, and serotonergic activity may vary across the seasons.[7] Increased 5HT transporter (SERT) binding in the fall and winter (which correlated with low levels of daily sunshine) could explain seasonal susceptibility to depressive symptoms.[8] In patients with winter depression, i.e. seasonal affective disorder (SAD), the hyperfunctional SERTstate is reversed with bright light therapy or natural summer remissions.[9] A substantial portion of SAD patients have suicidal ideation (SI) during an acute winter depressive episode (80/191 = 42%).[10] Suicidal symptoms resolved in 45% of the SAD patients with appropriate bright light therapy.[10] Seasonal effects also may introduce risk for suicidality and suicide completion during the spring or summer months in patients with aggressive traits[11] or other affective illness such as bipolar disorder.[12] Completed suicides (especially violent deaths of male victims) peak during the spring and summer in parallel to increased levels of bright sunlight.[11] The seasonal changes in sunlight levels on brain monoamines[13] could have different effects in patients with SAD versus patients with other affective disorders.

There is limited information on the seasonality of depressive symptoms and SI in postpartum mothers.[14–17] Earlier reports suggested an increased PPD risk in the autumn and decreased risk in the spring[17] and an increased odds for global seasonality in mothers with DSM-IV confirmed PPD.[16] However, others did not replicate the findings.[14,15] The previous studies of seasonality and PPD risk were relatively small[15–17] or encumbered by study design constraints.[14] The constraints of study methodology and design included the use of nonvalidated screening questions (albeit similar to the validated PHQ-2 measure), different scoring system from the PHQ-2, unclear time frame covered by the questions and retrospective reporting (investigators mailed out surveys 2–5 months post-delivery to inquire about symptoms in the early postpartum period; http://www.cdc.gov/prams/methodology.htm).[14]

In this prospective study, the authors explored the seasonal variation in risk for depression and SI in postpartum women. We hypothesized that postpartum women have an increased frequency of depression risk (Edinburgh Postnatal Depression Scale (EPDS) ≥ 10) in the winter and SI (EPDS item 10 ≥ 1) in the spring compared to other times of the year.

Materials and Methods

The study was approved by the University of Pittsburgh Institutional Review Board. The study team conducted telephone depression screenings of new mothers within 4–6 weeks after delivery. Recruiters (nurses or social workers) visited the mothers on the postpartum units and obtained a waiver of written informed consent for the phone screen. The waiver allowed the nurses to obtain contact information from the interested participants directly.

Eligibility

Participants included new mothers ≥ 18 years who had recently given birth to a live infant, were English speaking and were able to provide the waiver of informed consent. Mothers without telephone access were excluded.

Depression Risk

The EPDS is a widely used, rapidly completed screening instrument to identify women with risk for PPD in the first year after childbirth.[18] The EPDS score covered the new mother's experience of depressive symptoms within a 1-week time frame.[18] An EPDS ≥ 10 (positive depression screening score) corresponds with acceptable levels of sensitivity and specificity (91 and 76%, respectively)[18] when concurrent diagnoses of major and minor depressive disorders were made by Research Diagnostic Criteria. A priori, we used the EPDS ≥ 10 cut-point to define an increased risk for a depressive disorder after delivery.

Suicide Risk

Item 10 of the EPDS is an inquiry about thoughts of self-harm. Possible responses are 0 = never, 1 = hardly ever, 2 = sometimes, and 3 = quite often. During the screening, participants who scored ≥ 1 on item 10 (indicating any thought of self-harm in the past 7 days) were staffed by an experienced clinician, and an immediate treatment intervention was developed to ensure participant safety.

Data Analysis

We assessed the cumulative percentage of participants, rates of positive EPDS scores, and any suicidal symptoms (item 10 ≥ 1; Table 1). For the association between positive EPDS ≥ 10 (categorical) and any or increased suicidal symptoms, we used the chi-square test and Fisher's Exact Test (count data). For the seasonal effect on positive EPDS scores and any suicidal symptoms, we used periodic binomial regression analysis (Fourier Basis).[19] For periodic binomial regression analysis, we assume a standard relationship between probability and variance; we confirmed that a more complicated model for a larger variance (over-dispersion) was not needed. Months were converted to radians (1 radian = $180/\pi$ degrees of a circle; therefore, 1 year = 2π). We explored for frequencies of one to four cycles (f1–f4; Table 3, Fig. 3).

Results

From 2006 to 2010, the study team telephone-screened 9,339 women for depression risk after delivery (Tables 1 and 2). The cumulative percent of patients per year is summarized in Table 2. The study accumulated 9.4% of patients in 2006, 36% in 2007, 67% in 2008, 95% in 2009, and 100% by March 2010. Among the women who received phone screenings, 14.5% (n = 1,316) had positive EPDS scores (EPDS ≥ 10) and 3.1% (n = 294) had any suicidal symptoms (item 10 ≥ 1; Table 1). The aggregated monthly rates (across the years) of positive EPDS scores were lowest in June (96/827 = 11.6%) and July (94/751 = 12.5%) and highest in November (153/928 = 16.5%) and December (132/824 = 16.0%) because the waiver of informed consent allowed only the collection of phone screening data and not the collection of demographic or detailed clinical data. Participants inhabited mainly Allegheny County which is composed of a population of 81% white, 13% African American, 2.5% Asian, 1.5% Hispanic, and 3% other (multirace, native American/Alaskan/Hawaiian/Pacific Islander) ancestries (quickfacts.census.gov/qfd/states/42/42003.html).

A positive EPDS score was associated significantly with any suicidality (item 10 ≥ 1)(odds ratio (OR) = 41.3, 95% confidence interval (CI) = 29.8–58.6, Pearson's χ^2 test with Yates correction = 1,243.9, df = 1, $P = 2.2 \times 10^{-16}$) and high-level SI (item 10 = 2 or 3) (OR =

217.1, 95% CI = 58.1–1,837.6, Pearson's χ^2 test = 394.8, df = 1, $P = 2.2 \times 10^{-16}$). Plots of the percent of patients with any or high-level suicidal symptoms on item 10 (*Y*-axis) against the total EPDS score (*X*-axis) (Figs. 1 and 2) indicated that the frequency of suicidal symptoms began to rise steeply for patients with an EPDS ≥ 15. Exploration of suicidal symptoms (item 10) and other depression symptoms on the EPDS indicated that the SI was correlated with a decrease in "the ability to laugh and see the funny side of things" (item 1, Spearman's rank correlation ρ = 0.26); a reduction in being able to "look forward to enjoyment of things" (item 2, ρ = 0.27); and mothers noticing that "I have been so unhappy that I have had difficulty sleeping" (item 7, ρ = 0.27).

For the relationship between seasonal variation and positive EPDS scores (with periodic binomial regression models), the baseline frequency of one cycle per year (f1) was significant (regression estimate = 0.117, standard error (*SE*) = 0.052, *z*-value = 2.26, *P* = 0.03). Positive EPDS scores varied significantly across the 12-month period; the frequency of positive EPDS scores was highest in December and lowest in July (Fig. 3). Other frequencies (f2 = two cycles per year, f3 = three cycles per year, and f4 = four cycles per year) were not significant for the relationship between seasonality and a positive EPDS score (Table 3). Periodic binomial regression analysis indicated no significant year–to-year effect on *positive EPDS scores* (Table 4). For the relationship between seasonal variation and any suicidal symptom (item 10 ≥ 1), we detected no significant variation across 12-months with period binomial regression models (Table 3; Fig. 3).

Discussion

From this large prospective study of 9,339 mothers after childbirth, the data indicate that the rate for PPD risk (14%) is consistent with rates published in the literature.[1] The evidence of a winter peak (December) for increased postnatal symptoms on the EPDS (Table 3, Fig. 3) aligns with reports of increased risk for PPD during the autumn months[17] but contrasts with other findings of no relationship between the season of childbirth and self-reported postpartum symptoms.[14] Design constraints (nonvalidated screening tool or scoring system, retrospective self-reporting) from the extensive survey by Jewell et al. may have resulted in the high detection rate of subclinical depression (43.55%) but failure to identify the seasonal pattern of depression risk. The seasonal peak in postnatal symptoms may be from a preexisting pattern of seasonal illness. Seasonal patterns of mood symptoms on the Seasonal Pattern Assessment Questionnaire are more common in women with PPD (*n* = 62, 29%) compared to healthy postpartum controls (*n* = 62; 14%).[16]

Similar changes in neurotransmitter processes could explain the mood symptoms in depression after delivery and winter depression. Remitted patients with SAD suffer depression relapse with depletion of the neuro-transmitters dopamine and norepinephrine from a tyrosine hydroxylase inhibitor.[20] The enzyme monoamine oxidase—A (MAO-A) is necessary to metabolize the monoamines 5HT, norepinephrine, and dopamine.[6] Within 4–6 days of delivery, the distribution of MAO-A in multiple brain regions is increased by 43%; brain MAO-A binding increased significantly in the early postpartum mothers compared to nonpostpartum controls.[6] Enhanced MAO-A activity could induce rapid declines in monoamine levels and profound changes in maternal mood such as the postpartum blues or PPD in women with depression risk. The biologic milieu after delivery could introduce risk for PPD possibly with a winter onset in susceptible patients.

Seasonal changes in mood symptoms can result from decreased sunlight exposure. Giving birth during the darker months in Finland is associated with increased depression risk.[17] The amount of daily sunshine may correlate with SERT activity.[8] Reduced sunlight exposure (in the autumn and winter) is associated with increased 5HT binding which may

change 5HT neurotransmission to contribute to depressive symptoms.[8] Light deprivation produces apoptosis of the neurons in the locus coeruleus (norepinephrine), dorsal raphe (5HT), and ventral tegmentum (dopamine), which are integral components of the neural systems related to depression.[21] Seasonality, light exposure, postpartum biological milieu, and a complex psycho-social environment are multiple factors that could interact to promote functional changes in the monoamine systems that contribute to postpartum depressive phenomenology.

The frequency of any SI (3%; Table 1) is lower than rates from earlier studies that involved screening of population-based mothers (n = 386, 8.3%),[22] mothers referred for psychotherapy (n = 317, 11.1%)[22] or psychiatric outpatients with major depression (58% = 156/269).[23] The steep rise in suicidal symptoms in mothers with increased depression risk (EPDS ≥ 15) is a major concern (Figs. 1 and 2). Suicide is the leading cause of maternal death after the first 42 postnatal days within the first postpartum year.[24] From 1997 to 1999, data from the UK Confidential Enquiries into Maternal Death and a study of death certificates linked with birth certificates suggested that 28% of maternal deaths resulted from suicide (68 suicides/242 deaths).[24] Because of the study design, we could not obtain information on maternal deaths or suicides. With a national suicide rate of 10–11 per 100,000,[25] our group is too small to provide a reliable estimate of the suicide rate.

After delivery, depressed (rather than nondepressed) mothers are much more likely to have suicidal symptoms. Mothers with suicidal thoughts frequently describe problems that are related to depressed mood. During a major depressive episode, women with suicidal symptoms (39 attempts/156 patient with SI),[23] past attempts,[26] or increased depression levels[27] are at risk for attempting suicide. In the study, mothers with thoughts of suicide declared reasons for living—responsibility toward their children, religious beliefs, or the experience of deep support from trusted family members. Having compelling reasons to live[28] and proper depression treatment can avert suicide related to major depression[29] and seasonal depression.[30]

The risk for postnatal depression peaks in the winter. In new mothers, suicidal symptoms are related to depressed mood but do not vary across the seasons. Postpartum women with past seasonal illness or new mothers who live in places with reduced sunlight should be monitored carefully for postpartum symptoms, especially in the fall and winter months. New mothers with depressive symptoms require careful clinical assessment for SI. Postpartum screening should be conducted by trained screeners as part of a clinical team of experienced clinicians/case managers and a psychiatrist. The clinical team is essential to provide high-risk patients with assessment of depression levels, suicidal symptoms, and prompt referrals for appropriate depression evaluation and management.

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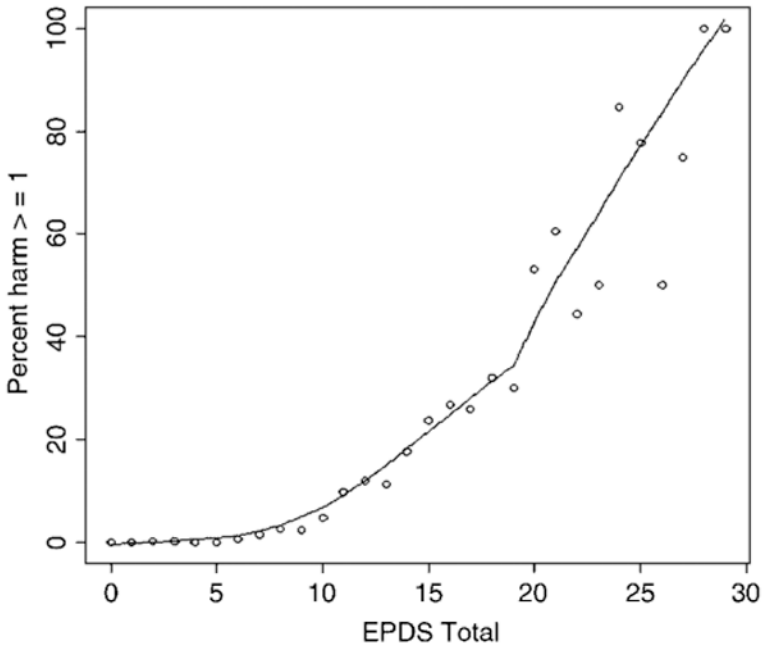

Figure 1. Percentage of patients with any suicidal ideation (item 10 ≥ 1) across EPDS Scores.
EPDS, Edinburgh Postnatal Depression Scale

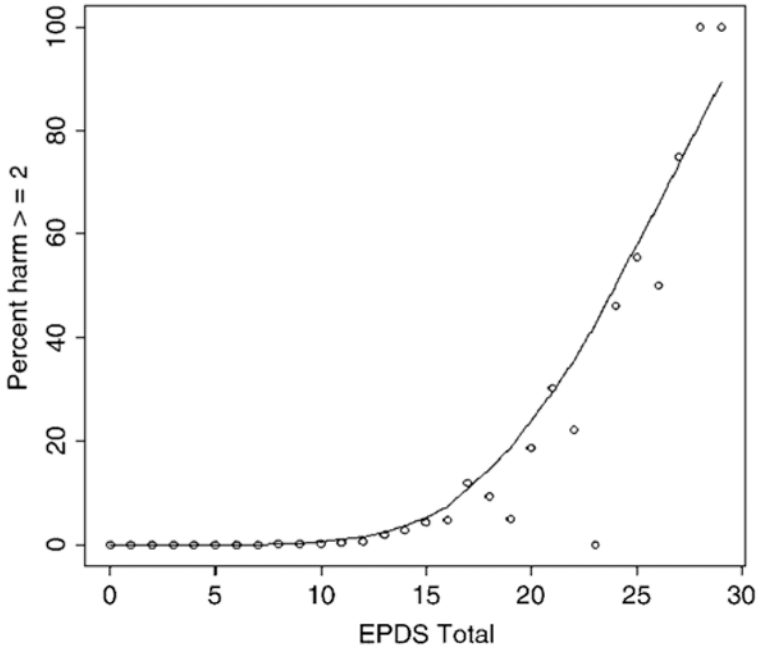

Figure 2. Percentage of patients with increased suicidal ideation (item 10 ≥ 2) across EPDS Scores. EPDS, Edinburgh Postnatal Depression Scale

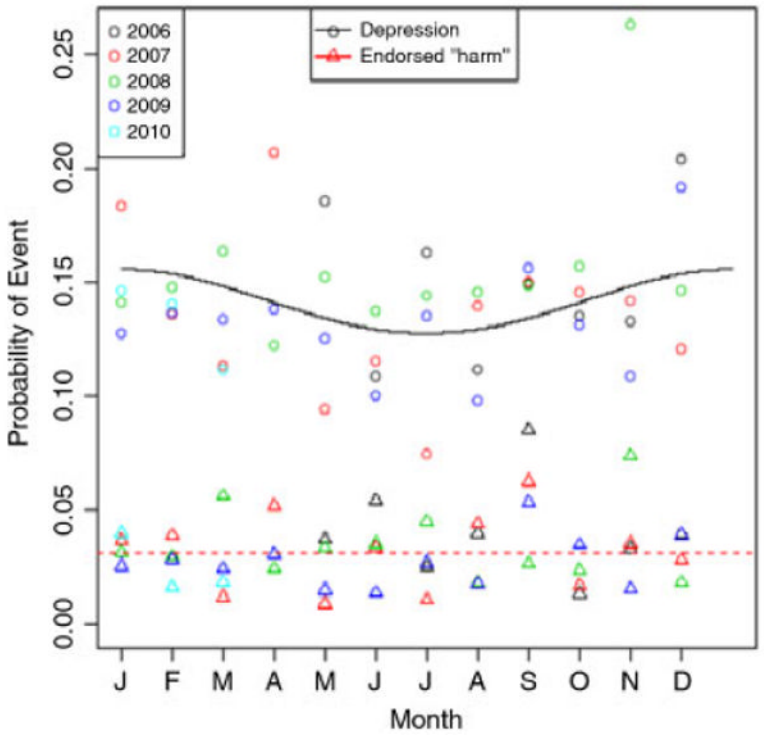

Figure 3. Frequency of positive EPDS scores (EPDS ≥ 10) and risk for suicidial ideation (item 10 ≥ 1) across the calendar months. EPDS, Edinburgh Postnatal Depression Scale. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

Table 1

The number and percent of women with positive EPDS scores (EPDS ≥ 10) and suicidal ideation (item 10>1) across calendar months

Month	#/month	EPDS<10	EPDS ≥ 10	%EPDS ≥ 10	Item 10 ≥ 1	%Item 10 ≥ 1
1	720	616	104	14.5	24	3.3
2	692	595	97	14	20	2.9
3	630	544	86	13.7	20	3.2
4	517	441	76	14.7	17	3.3
5	775	673	102	13.2	17	2.2
6	827	731	96	11.6	24	2.9
7	751	657	94	12.5	21	2.8
8	877	766	111	12.7	25	2.9
9	758	643	115	15.2	39	5.1
10	1,040	890	150	14.4	24	2.3
11	928	775	153	16.5	38	4.1
12	824	692	132	16	25	3
Totals	9,339	8,023	1,316	14.1	294	3.1

EDPS, Edinburgh Postnatal Depression Scale.

Table 2
Cumulative and percent screened each year

	#months	Frequency	Percent	Cumulative percent
2006	8	876	9.4	9.4
2007	12	2,516	26.9	36.3
2008	12	2,873	30.8	67.1
2009	12	2,608	27.9	95
2010	3	466	5	100
Total	47	9,339	100	100%

Table 3

Seasonal effect on positive EPDS (EPDS ≥ 10) or any suicidal ideation (item 10 ≥ 1)

	Periodic binomial regression [Fourier Basis]				
	Frequency	**Estimate**	***SE***	***z*-value**	
	Months converted to radians (1 year = 2π radians)				***P* (*z*-value)**
EPDS ≥ 10	f1 (single frequency)	0.117	0.052	2.26	0.03*
	f2	−0.0631	0.042	−1.48	0.1
	f3	−0.00518	0.043	−0.12	0.9
	f4	−0.0105	0.043	−0.25	0.8
	Null deviance = 72.50, *df* = 46	Residual deviance = 64.82, *df* = 45			
Item 10 ≥ 1	f1	0.0452	0.11	0.42	0.7
	f2	−0.0474	0.11	−0.43	0.7
	f3	0.0229	0.11	0.21	0.8
	f4	−0.104	0.11	−0.94	0.4
	Null deviance = 66.98, *df* = 46	Residual deviance = 64.90, *df* = 41			

*Significant effect of seasonality on positive EPDS for a single frequency. EPDS, Edinburgh Postnatal Depression Scale.

Table 4

Year-to-year effect on positive EPDS

Periodic binomial regression using the Fourier Basis				
Frequency	**Estimate**	***SE***	***z*-value**	***P* (*z*-value)**
2007	−0.159	0.11	−1.41	0.2
2008	0.051	0.11	0.47	0.6
2009	−0.146	0.11	−1.30	0.2
2010	−0.142	0.18	−0.81	0.4
Null deviance = 72.502, *df* = 46	Residual deviance = 51.891, *df* = 37			

Note: Year-to-year mean differences in positive EPDS are not statistically significant. EPDS, Edinburgh Postnatal Depression Scale.