JOGNN CLINICAL RESEARCH

The Impact of Fatigue on the Development of Postpartum Depression

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Background: Previous research suggests early postpartum fatigue (PPF) plays a significant role in the development of postpartum depression (PPD). Predicting risk for PPD via early identification of PPF may provide opportunity for intervention.

Objective: To replicate and extend previous studies concerning the impact of PPF on symptoms of PPD and to describe the relationships among PPF, PPD, and other variables using the theory of unpleasant symptoms.

Design: Correlational, longitudinal study.

Setting: Participants' homes.

Participants: Convenience sample of 42 community-dwelling women recruited before 36 weeks of pregnancy.

Main Outcome Measures: PPF, depressive symptoms, and stress measured during prenatal weeks 36 to 38, and on Days 7, 14, and 28 after childbirth. Salivary cortisol was measured as a physiological marker of stress.

Results: Significant correlations were obtained between PPF and symptoms of PPD on Days 7, 14, and 28, with Day 14 PPF levels predicting future development of PPD symptoms in 10 of 11 women. Perceived stress, but not cortisol, was also correlated with symptoms of PPD on Days 7, 14, and 28. Women with a history of depression had elevated depression scores compared to women without, but no variable was as effective at predicting PPD as PPF.

Conclusions: Fatigue by Day 14 postpartum was the most predictive variable for symptoms of PPD on Day 28 in this population. *JOGNN, 34, 577–586; 2005.* DOI: 10.1177/0884217505279997

Keywords: Cortisol—Fatigue—Postpartum depression—Stress—Theory of unpleasant symptoms

Accepted: November 2004

Background

Postpartum depression (PPD) is a relatively common and potentially devastating disorder that develops in women within the 1st year after giving birth (Steiner, 1998; Wood, Thomas, Droppleman, & Meighan, 1997). Prevalence rates are high, with estimates of approximately 12% for major and 19% for minor depression (Beck & Gable, 2001; Hopkins, Marcus, & Campbell, 1984; Whiffen, 1992). The implications of PPD extend beyond simply dampening the pleasure a new mother may feel after giving birth and in fact may result in serious risk to mother and infant. Even without overt risks to health, subtle interruptions in maternal-infant bonding may occur, with negative effects on infant behavioral and cognitive development (Beck, 1995; Cooper & Murray, 1998; Holden, 1991). Furthermore, these effects may last years beyond infancy (Beck, 1998; Cox, Puckering, Pound, & Mills, 1987; Field, 1984; Field et al., 1988; Holden, 1991; Stein et al., 1991; Whiffen & Gotlib, 1989), and other family members, including partners and older children, may also suffer (Boath, Pryce, & Cox, 1998; Holden, 1991). A number of psychosocial variables, including previous depression, child care stress, difficult infant temperament, low self-esteem, and poor social support have been identified as contributing to a woman's

risk of developing PPD (Beck, 2003; Beck & Gable, 2001). At this time, however, there are no clear tools available to accurately identify whether an otherwise healthy woman will develop PPD.

Recently, we identified severe postpartum fatigue (PPF) as a physiological variable whose presence early in the postpartum period significantly increases a woman's risk of developing symptoms of PPD (Bozoky & Corwin, 2002). Specifically, in a study of 37 postpartum women, 13 of the 14 who rated themselves as significantly fatigued at 2 weeks postpartum went on to develop symptoms of PPD at 1 month postpartum. Because of the strength of this association and because of the significant implications for practice that could come from such a predictive relationship, we decided to replicate this study in a second group of women and to extend the investigation to include other variables that might influence the fatigue-depression relationship. Confirmation of the original findings would provide support for the development of an intervention aimed at prevention of PPF and ultimately at a reduction in the development of PPD.

Women frequently reported experiencing fatigue during the postpartum period.

Theoretical Framework

The theoretical framework for this study is based on the middle-range theory of unpleasant symptoms (Lenz, Pugh, Milligan, Gift, & Suppe, 1997; Lenz, Suppe, Gift, Pugh, & Milligan, 1995). Within this framework, PPD is conceptualized to be a multidimensional experience influenced by situational, psychological, and physiological factors. These factors in turn are conceptualized to interact with and influence each other. By using this framework, we sought to identify a constellation of factors contributing to PPD in an otherwise well population of postpartum women.

Situational factors are by nature unfixed in that they have the potential to change at any time. In this study, situational factors under evaluation included the presence of a husband or significant other living with the mother, the presence of other children at home, and the presence of extended family (sibling or parent) living within 60 miles of the mother and her infant. Because previous research suggests that women living in a rural community may be at increased risk of experiencing PPD (Creedy, 1993; Griepsma et al., 1994) and because of the large number of rural women in the surrounding areas, we also included rurality as a situational variable.

Physiological factors are both fixed and unfixed. Fixed psychological factors include personal history of depression and a family history of depression. Unfixed psychological factors include an individual's level of stress, both perceived by the individual and as reflected by secretion of the stress hormone cortisol. The fixed physiological factors chosen for evaluation included age and postpartum status. Because of several known physiological contributors to fatigue, including iron deficiency anemia (Ludwig & Strasser, 2001; Ross et al., 2003; Turkoski, 2003), thyroid hormone deficiency (Cooper & Murray, 1998), and postpartum inflammatory status (Corwin, Bozoky, Pugh, & Johnston, 2003), fatigue is placed in the model as an unfixed physiological factor, although it likely has psychological and situational components as well. The factors identified with interconnecting influences are presented in Figure 1.

Hypothesis

In the following study, data were collected to explore the hypothesis that women who report severe fatigue at 1 and 2 weeks postpartum are significantly more likely to develop symptoms of PPD at 1 month postpartum compared to women who do not report severe fatigue at the same time. The relationship between PPF and other variables known or suspected to influence the risk of PPD including stress; personal and family history of depression; the presence of spouse, partner, or other children in the home; the presence of family living nearby; and rural status are included to increase the robustness of the model. Changes in fatigue, perceived stress, and cortisol level over time were investigated to identify alternative patterns of change between women with and without symptoms of depression.

Method

Sample

A convenience sample of 42 women was recruited for this correlational, longitudinal study. Participants included those living in urban areas and those residing in rural counties as defined by the U.S. Census Bureau's census 2000 data (U.S. Bureau of the Census, 2001). Women were invited to participate if they met the following inclusion criteria: between the ages of 18 and 35 years, past and present history of good health including current pregnancy, under no pregnancy restrictions concerning activity or diet, and not taking any prescribed medications except prenatal vitamins. Postpartum inclusion requirements were that the birth was vaginal without postpartum hemorrhage, that it resulted in a full-term singleton

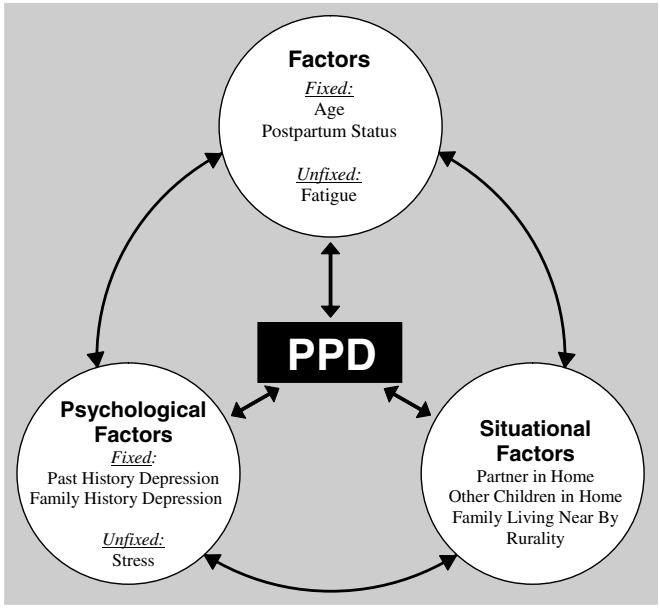

FIGURE 1
Factors proposed to contribute to the development of postpartum depression (PPD).

infant without complications, and that both mother and infant left the hospital within 48 hours. Furthermore, if at any time during the study, any serious illness developed in the mother or infant or if they required any medications other than maternal postnatal vitamins or minor medications such as docusate sodium (Colace), they would be discontinued from the study.

Instrumentation

Fatigue. The Modified Fatigue Symptom Checklist (MFSC) consists of 30 statements measuring psychological and physical symptoms of fatigue (Yoshitake, 1978). In the MFSC, participants are asked to answer statements describing symptoms they have generally experienced since giving birth or during the past 2 weeks with either a "yes" or a "no" response, scoring a maximum of 30 points. The higher the score, the more fatigue the participant is experiencing. This checklist was modified (Pugh, Milligan, Parks, Lenz, & Kitzman, 1999) to provide clearer directions, and the instrument was tested on a large longitudinal sample of postpartum women (N = 285). Concurrent validity of this measure was demonstrated by significant correlations with a single tiredness visual analog scale and the MFSC (r = .64; p < .01). Construct validity has been supported by significant correlations (p < .05) in the appropriate direction, with two psychometrically sound instruments measuring related constructs: the Center for Epidemiological Studies–Depressive Symptomatology Scale (CES-D; Radloff, 1977) and the Spielberger State-Trait Anxiety Inventory (Spielberger, 1984). This is consistent with the conceptual issue of the distinction between fatigue and depression during the postpartum period as reported by Milligan, Lenz, Parks, Pugh, and Kitzman (1996). In the Pugh et al. (1999) study, the internal consistency reliability (Kuder-Richardson formula) ranged from .82 to .85. Cronbach's alpha reliability in the current study ranged from .81 to .91 during the postpartum period.

Depression. The CES-D is a 20-item, self-report scale used in past studies of depression in postpartum women (Campbell & Cohn, 1991; Carter, Baker, & Brownell, 2000; Greene, Nugent, Wieczorek-Deering, O'Mahony, & Graham, 1991; Pascoe & French, 1990; Troy, 1999; Wilcox, Field, Prodromidis, & Scafidi, 1998). It has been shown to be a valid and reliable measure of symptoms of depression and as a screening tool for further evaluation (Radloff, 1977). The instrument has fewer items measuring confounding somatic symptoms associated with childbirth (Campbell & Cohn, 1991). Wilcox and colleagues (1998) reported that adolescent mothers have a preference for the simpler and shorter CES-D over other depression screening tools. Statements such as "I felt that everything I did was an effort" and "People were unfriendly" are read by participants who then indicate how often they felt the same way during the previous week by marking on a 4-point scale ranging between 0 (*rarely or none of the time*) and 3 (*most or all of the time*). Of the possible 0 to 60 points that can be scored on the CES-D, the higher the score, the more symptomatic an individual is of depression. A cutoff point of 16 is used to identify severe depression and 11 to identify mild depression (Radloff, 1977). Cronbach's alpha reliability in the current study ranged from .77 to .91 during the postpartum period.

Stress. The Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) is a 14-item measure of global perceived stress. Participants rate how often over the past month they have "been upset because of something that happened unexpectedly," "felt nervous and stressed," or "felt things were going your way." The responses range from 0 (*never*) to 4 (*very often*), with several items reverse scored. High scores connote more stress. This scale is widely used and has been validated for several groups including pregnant and postpartum women (Chen, Wang, Hwu, & Chou, 2000; Lowenkron, 1999). In Cohen's original report, reliability was high (alphas ranged from .84-.86), as was the test-retest correlation (.85). Evidence for concurrent and predictive validity was significant at p < .05 (r = .49). In the current study, Cronbach's alpha reliability during the postpartum ranged from .70 to .84.

Salivary cortisol concentration provides a second measure of stress in this study. Salivary cortisol is easily collected and is considered the best indicator of free

(active) cortisol, the most accurate biological marker of stress (Harris et al., 1996).

Procedure

Participants were recruited before their 36th week of pregnancy via newspaper ads, visits to local prenatal classes, and postings placed at the offices of obstetrician-gynecologists. Women interested in participating called a phone number provided. During the first telephone contact, potential participants were screened, and those meeting inclusion criteria were scheduled for their first home visit to be held during weeks 36 to 38 of pregnancy. Participants were instructed to abstain from eating, drinking, and brushing their teeth the morning of each visit to standardize saliva collection.

During the first home visit, written informed consent was obtained, after which baseline demographic information was collected. Participants next completed questionnaires on fatigue (MFSC), depression (CES-D), and stress (Perceived Stress Scale). They then were asked to provide a saliva sample by expectorating into a sterile 25-mL plastic tube. The sample was returned to the laboratory, where it was placed in a deep freezer (–70°C) until assayed for cortisol by enzyme-linked immunosorbant assay. At the end of the first home visit (prenatal), all participants were requested to contact the researcher as soon as possible after giving birth at a telephone number provided. If participants had not responded by their 40th week gestation, one of the researchers called them to check on the status of their pregnancy. After confirmation that a healthy infant had been born and that both mother and child continued to meet inclusion criteria, a second home visit was arranged for Day 7 postpartum. The same data collection procedures were implemented on Days 14 and 28 as had been followed at the prenatal and Day 7 visit.

To ensure that all home visits were successfully completed, phone calls to remind participants were made the night before each of the scheduled visits. In addition, if the participant could not meet on the exact date requested, an alternative date, +2 days, was chosen. All home visits occurred between 9:00 a.m. and 10:00 a.m. to control for diurnal variation in cortisol secretion (King & Hegadoren, 2002; Pruessner et al., 1997). The Pennsylvania State University Internal Review Board provided full approval for this protocol.

Cortisol Assay

Salivary samples were defrosted slowly while maintained on ice, and the concentration of cortisol was measured using a standard enzyme-linked immunosorbant assay kit (Salimetrics, University Park, PA). All samples were tested in duplicate; values that varied by more than 5% were subject to repeat testing. To minimize variability, all samples from each participant were assayed on the same plate. Level of detection was from 0.1 to 18.0 ng/dL. Interassay variability ranged from 0.89 to 0.14 µg/dL, and intraassay variability ranged from 0.53 to 0.13 µg/dL.

Data Analysis

Data were analyzed using SPSS. The level of significance was set at .05. Demographic data were plotted and descriptive statistics compiled. Correlations between self-report of fatigue, stress, cortisol concentration, and symptoms of PPD were evaluated at each time point using Pearson's product–moment correlations. Repeated-measures ANOVAs were used to identify time-related changes in fatigue, stress, and salivary cortisol concentration and to determine a time-by-depression interaction. Paired analysis was used to identify significant changes in fatigue over time. Separate one-way ANOVAs were run using demographic and self-report data as independent variables with the score on the CES-D at Day 28 as the dependent variable. For ancillary analyses, participants were separated based on whether they demonstrated significant symptoms of depression on Day 28. Those scoring less than 11 on the Day 28 CES-D were considered without significant symptoms of depression, whereas those scoring greater than 11 on the CES-D on Day 28 were classified as demonstrating significant symptoms of depression (Radloff, 1977). Separate one-way ANOVAs were applied to evaluate differences in age, fatigue, stress, and salivary cortisol concentration between these two groups of women. Descriptive statistics were used to estimate cutoff MFSC scores for women at risk of depression.

Results

Demographic and Personal Data

Of the 42 participants entering the study, 98% were White and 2% were Hispanic. Maternal age ranged from 21 to 35 years, with a mean age of 28.4 years (*SD* = 4.1). The majority of women (83%) were married or living with a partner. Census data demonstrated that 37% were living in a rural area. More than half of the women (68%) had no other children at home, whereas 23% had one and 9% had more than one other child at home. Twenty-one percent of the women reported a history of depression, with 16% having received treatment for the condition. Thirty-five percent of the women reported a family history of depression. None of the women were working outside the home during the time of this study.

Of the original 42 participants, 11 left or were discontinued from the study before completion due to giving birth by cesarean delivery, relocation, or illness in infant or mother. Of the remaining 31 women who completed

TABLE 1
Pearson Correlation (Level of Significance) Between Self-Reports of Fatigue at Each Time Point Using the Modified Fatigue Symptom Checklist, Stress Using the Perceived Stress Scale, and Depression Index at Day 28

	Fatigue			*Stress*				*CES-D*			
	Day 7	*Day 14*	*Day 28*	*Prenatal*	*Day 7*	*Day 14*	*Day 28*	*Prenatal*	*Day 7*	*Day 14*	*Day 28*
Fatigue											
Prenatal	.685	.573	.542	.480	.404	.360	.468	.618	.389	.513	.494
	(.000*)	(.001*)	(.002*)	(.001*)	(.033)	(.047)	(.009)	(.000*)	(.014)	(.003*)	(.006)
Day 7		.798	.683	.386	.415	.406	.520	.321	.460	.529	.542
		(.000*)	(.000*)	(.042)	(.028)	(.032)	(.005*)	(.096)	(.014)	(.004*)	(.003*)
Day 14			.843	.465	.541	.573	.649	.523	.424	.625	.701
			(.000*)	(.008)	(.003*)	(.001*)	(.000*)	(.003)*	(.025)	(.000*)	(.000*)
Day 28				.590	.534	.633	.734	.647	.377	.636	.771
				(.001*)	(.003*)	(.000*)	(.000*)	(.000*)	(.048)	(.000*)	(.000*)
Stress											
Prenatal					.648	.706	.857	.613	.439	586	.714
					(.000*)	(.000*)	(.000*)	(.000*)	(.019)	(.001*)	(.000*)
Day 7						.781	.657	.511	.704	.722	.670
						(.000*)	(.000*)	(.005*)	(.000*)	(.000*)	(.000*)
Day 14							.854	.490	.620	.691	.753
							(.000*)	(.005*)	(.000*)	(.000*)	(.000*)
Day 28								.647	.557	.658	.875
								(.000*)	(.002*)	(.000*)	(.000*)
CES-D											
Prenatal									.366	.632	.634
									(.055)	(.000*)	(.000*)
Day 7										.681	.567
										(.000*)	(.002*)
Day 14											.728
											(.000*)

Note. CES-D = Center for Epidemiological Studies–Depressive Symptomatology Scale. Prenatal $n = 42$, Day 7 $n = 28$, Day 14 $n = 31$. Adjusted for multiple comparison, $p < .005$.

*Correlation is significant.

the study, 4 (13%) reported having been diagnosed with depression in the past, with all 4 reporting they had been medically treated. Twelve of the 31 women (39%) reported a family history of depression, including all 4 women who reported having a personal history of depression. By the final visit on Day 28, of the 31 women remaining in the study, 84% were breastfeeding their infants at least 50% of the time.

Fatigue, Stress, and Development of Depression

Using correlational analysis, at each measurement time, both self-report of fatigue and perceived stress were significantly correlated with self-report of depressive symptomatology and with each other (see Table 1). On Day 7, fatigue accounted for 29% of the variance in depressive symptoms at Day 28. This increased to 49% by Day 14 and to 59% by Day 28. Stress level as perceived over the past month accounted for an even greater variance in depressive symptoms, at 45% on Day 7, 57% on Day 14, and 77% on Day 28. There was no correlation between salivary cortisol concentration and depressive symptoms, PPF, or perceived stress. There was no correlation between age and the variables depression, fatigue, or stress, at any time point.

Alternative patterns of change over time among women were evaluated using repeated-measures ANOVA. Inspection of findings revealed a significant time effect, $F(3, 78) = 6.650$, $p < .001$, and significant time-by-depression

Fatigue and perceived stress were correlated with symptoms of postpartum depression.

effect for fatigue, $F(3, 78) = 3.732$, $p = .015$. In women who scored as nonsymptomatic of depression as determined by a Day 28 CES-D score less than 11, fatigue peaked during the prenatal visit and then fell over the next 4 weeks. As shown in Figure 2, in nondepressed women, self-report of fatigue (mean and standard error) fell from a prenatal level of 7.40 (±0.94) to 4.95 (±0.61) on Day 7 to 3.45 (±0.48) on Day 14 and to 2.20 (±0.45) on Day 28, with the changes between each sampling period significant ($p < .05$). In women who scored greater than or equal to 11 on the CES-D on Day 28, although fatigue score also was highest during the prenatal period at 11.30 (±1.63), there were no significant differences in fatigue between Day 7 (9.88 ± 1.74), Day 14 (9.91 ± 1.30), and Day 28 (9.91 ± 1.16). As shown in Figure 2, the difference in fatigue scores between women scoring greater than or equal to 11 on the CES-D on Day 28 compared to women scoring less than 11 was significant at each sampling point.

There was also a significant time effect for cortisol concentration, $F(3, 72) = 10.785$, $p < .001$, with levels highest (mean and standard error) during the prenatal period (6.55 µg/dL ± 0.41) and decreasing significantly from that value on Day 7 (4.44 µg/dL ± 0.47, $p < .001$), Day 14 (3.98 µg/dL ± 0.46, $p < .001$), and Day 28 (3.59 µg/dL ± 0.38, $p < .001$). There were, however, no significant differences between the later sampling times and no significant time-by-depression effect for cortisol. There was no significant time effect for stress during this study.

Inspection of descriptive statistics indicated that on Day 14, a value of less than 6 on the MFSC was representative of approximately 50% of the women. Therefore, a value of greater than or equal to 6 on Day 14 was selected as a threshold score indicative of above average fatigue in this population. This threshold is consistent with previous results from our laboratory (Bozoky & Corwin, 2002). ANOVA indicated a significant difference in Day 28 CES-D score (mean and standard error) in women reporting greater than average fatigue (11.93 ± 1.67) compared to women reporting below average fatigue (4.94 ± 0.92; $t = –3.843$, $df = 29$, $p = .001$). Likewise, CES-D score (mean and standard error) on Day 28 was significantly higher in women reporting a personal history of depression (15.50 ± 1.94) compared to those without such a history (7.00 ± 1.08; $t = –2.915$, $df = 29$, $p = .007$). There were no significant differences in Day 28

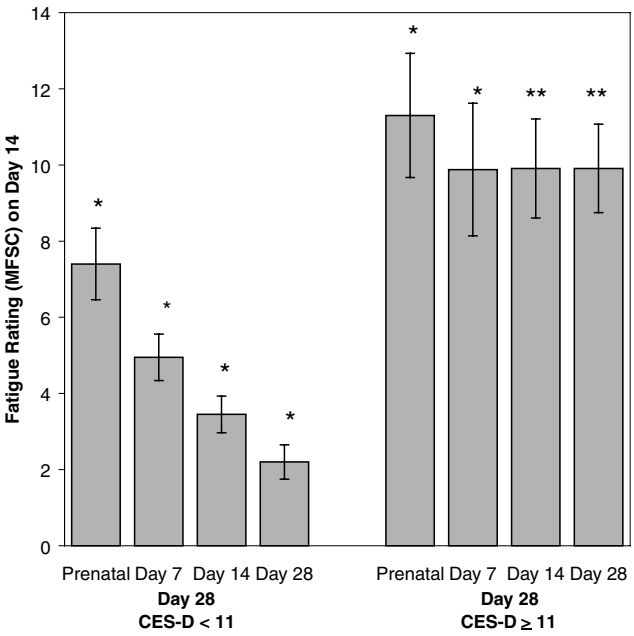

FIGURE 2
Fatigue score during the prenatal visit and on Days 7, 14, and 28 in women scoring nonsymptomatic of depression on Day 28 (CES-D < 11) and symptomatic of depression on Day 28 (CES-D ≥ 11).

Note. Day 14 fatigue scores were significantly different at each sampling time for women in Center for Epidemiological Studies–Depressive Symptomatology Scale (CES-D) less than 11 group and between Day 28 CES-D groups at each time point).

*$p < .05$. **$p < .001$.

CES-D scores based on a woman's marital status, presence of other children at home, type of infant feeding, rurality, family living within 60 miles, or family history of depression, although both family history of depression ($t = –1.955$, $df = 29$, $p = .060$) and presence of other children at home ($t = –1.913$, $df = 29$, $p = .066$) approached significance. There were no significant differences in self-report of fatigue at any time based on marital status, rurality, other children at home, or family living within a 60-mile radius. Women who continued to exclusively or primarily breastfeed their infants by the end of the study tended to be slightly, although not significantly, more fatigued than women who were bottle-feeding their infants on Day 28 (1.40 ± 1.67 vs. 5.62 ± 4.74, $p = .06$). As shown in Table 1, perceived stress was significantly correlated with self-report of fatigue.

Ancillary Analysis

The CES-D score (mean and standard error) measured on Day 28 for all participants ($n = 31$) was 8.10 (±1.09) with a range from 0 to 21. Based on the cutoff score of greater than or equal to 11 as indicative of moderate symptoms of depression, 20 of the 31 women (65%) were

TABLE 2

Sensitivity and Specificity of Using Fatigue Score on Day 14 Postpartum to Predict Depression on Day 28

	Actual Health Condition of Participant	
Prediction	*Symptomatic of Depression on Day 28*	*Nonsymptomatic of Depression on Day 28*
Depression predicted to exist on Day 28 based on fatigue score on Day 14 of ≥6	True positive, 10/11	False positive, 4/20
Depression predicted to be absent on Day 28 based on fatigue score on Day 14 of <6	False negative, 1/11	True negative, 16/20

considered nondepressed, scoring less than 11 on the CES-D on Day 28 (mean CES-D score = 4.30 ± 0.69), whereas 11 women (35%) scored as symptomatic of depression on Day 28 (mean CES-D score = 15.0 ± 1.03). As shown in Table 2, by using the cutoff score previously identified of greater than or equal to 6 on the MFSC administered at Day 14 postpartum as indicative of elevated fatigue, health care providers would have positively identified 10 of these 11 women at risk of later developing PPD (91% true positive). Of these 11 women, 7 had a family history of depression and 4 had a personal and a family history of depression.

Discussion

In this study, women who experienced high levels of fatigue at Day 14 also scored significantly symptomatic of depression on Day 28. This finding supports and extends previous research identifying fatigue as a significant contributor to the development of PPD (Bozoky & Corwin, 2002; Troy, 1999; Whiffen, 1992) and is consistent with the middle-range theory of unpleasant symptoms. This association does not imply, however, that all fatigue is abnormal or detrimental; in fact, fatigue is a common experience for women during the postpartum period and likely plays a role in helping a new mother get the rest she needs to recover and heal from the physical and mental stressors of childbirth. Feelings of fatigue also may be important in providing a new mother quiet time with her infant. What is unusual and detrimental to a new mother is fatigue that is relentless, as indicated by the different pattern of PPF in women who start down the slope toward PPD as compared to those who do not, at least as determined over the time course of this study. As described above, most women demonstrate a smooth decline in fatigue over the course of the first 1 to 2 weeks postpartum. The transition to new motherhood may not be progressing smoothly, however, for the small group of women for whom the level of fatigue remains high at 2 weeks postpartum. For these women, an intervention aimed at encouraging rest and quiet time may be essential.

Severe fatigue was the best predictor of a woman developing symptoms of postpartum depression.

Because of the strong association between PPF and PPD, it is possible that by administering the fatigue checklist at 2 weeks postpartum, even over the phone, health care providers could predict early on women at risk of developing PPD. As shown in Table 2, by using a cutoff score of greater than or equal to 6 on the MFSC administered at 2 weeks postpartum, health care providers would have positively identified 10 of the 11 women at risk of later developing PPD (91% true positive). Likewise, history of depression is an excellent indicator of women at risk of PPD; of the 4 women who reported they had suffered depression in the past, all went on to show signs of PPD. However, by using this information alone, 7 of the women who went on to score as symptomatic of PPD would not have been predicted to do so because they did not have such a history. Similarly, of the 12 women completing the study who reported a family history of depression, 7 scored greater than or equal to 11 on the CES-D on Day 28, again confirming that a family history of depression might help identify women at risk of PPD. However, using this method, we would have missed identifying 4 women at risk.

Like fatigue, self-report of stress over the preceding month was highly correlated with symptoms of depression at each time point. Previous research suggests that the ways in which an individual responds to stressful events may be particularly relevant to the development of depression, especially in women (Kuehner, 2003; Strohle & Holsboer, 2003; Warnock & Clayton, 2003). The use of self-report of stress to predict future PPD is less compelling than fatigue, however, because there was no sig-

nificant change in stress over time in the group as a whole. In addition, in this study, participants were asked to reflect over the past month when rating their stress level, which meant that the stress associated with pregnancy, labor, and birth might have contributed to their perception of stress.

The dissociation seen in this study between cortisol secretion and self-perceived stress has been reported many times previously in the literature (Peters et al., 1998), with investigators often finding little or no consistency between the presence of a stressor and elevated cortisol secretion (Biondi & Picardi, 1999; Dickerson, Kemeny, Aziz, Kim, & Fahey, 2004; Malarkey, Pearl, Demers, Kiecolt-Glaser, & Glaser, 1995). The relationship between cortisol secretion and perceived stress may be even more labile in the current study given the dominating effects of pregnancy, labor, and delivery on the hypothalamic-pituitary-adrenal axis (Mastorakos & Ilias, 2003). There were no effects of marital status, age, family history of depression, family living nearby, other children at home, method of feeding, or rurality on CES-D scores; hence, these variables also would not be helpful in predicting PPD. Moreover, given their conceptualization as situational factors within the middle-range theory of unpleasant symptoms, the possibility exists that they were not the appropriate factors to evaluate.

Limitations

Limitations to this study include its relatively small sample size and the homogeneity of the sample. In addition, self-selection of participants occurred because all participants volunteered. A longer time interval for final follow-up could have altered the final total number of women with symptoms of PPD.

In summary, this study suggests a window of opportunity during which time a postpartum woman, who might otherwise not be suspected of being at risk of PPD, can be identified before significant symptoms develop by screening for unrelenting fatigue. Ultimately, a woman identified as severely fatigued during a routine postpartum or newborn visit, or even during a phone call to her home, could be followed more closely or offered an effective intervention. Future research to determine what factors contribute to prolonged PPF, for example, iron deficiency, overt or covert thyroid deficiency, or an excessive inflammatory response to parturition, could help ensure that the intervention related to PPF is an effective one.

Acknowledgment

Supported by a grant from Association of Women's Health, Obstetric and Neonatal Nurses and the Pennsylvania State General Clinical Research Center, funded by the National Institutes of Health (RR10732).

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