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Loss of Resources and Hurricane Experience as Predictors of Postpartum Depression Among Women in Southern Louisiana

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Abstract

Background: After a natural disaster, mental disorders often become a long-term public health concern. Previous studies under smaller-scale natural disaster conditions suggest loss of psychosocial resources is associated with psychological distress.

Methods: We examined the occurrence of depression 6 and 12 months postpartum among 208 women residing in New Orleans and Baton Rouge, Louisiana, who were pregnant during or immediately after Hurricane Katrina's landfall. Based on the Conservation of Resources (COR) theory, we explored the contribution of both tangible/financial and nontangible (psychosocial) loss of resources (LOR) on the outcome of depression, measured using the Edinburgh Postnatal Depression Scale (EPDS). We also investigated the influence on depression of individuals' hurricane experience through a Hurricane Experience Score (HES) that includes such factors as witnessing death, contact with flood waters, and injury to self or family members.

Results: Both tangible and nontangible LOR were associated with depression cross-sectionally and prospectively. Severe hurricane exposure (high HES) was also associated with depression. Regression analysis showed LOR-associated depression was explained almost entirely by nontangible rather than tangible factors. Consistent with COR theory, however, nontangible LOR explained some of the association between severe hurricane exposure and depression in our models. A similar result was seen prospectively for depression at 12 months, even controlling for depression symptoms at 6 months.

Conclusions: These results suggest the need for preventive measures aimed at preserving psychosocial resources to reduce the long-term effects of disasters.

Introduction

In late August 2005, Hurricane Katrina devastated the U.S. Gulf Coast, affecting 9.7 million people in the states of Louisiana, Mississippi, and Alabama alone.[1] The storm flooded 80% of New Orleans and displaced more than 250,000 people.[2] Hurricane Katrina was the costliest natural disaster in U.S. history, costing an estimated $125 billion, and the deadliest US storm since 1928.[2]

The World Health Organization (WHO) indicates that there is a distinct lack of research regarding gender issues in disaster situations.[3] There is evidence, however, of gender differentiation involving exposure to risk, risk perception, physical and psychological impact, recovery, and other aspects of the disaster process. Several studies have identified pregnant women as being a particularly vulnerable population during disaster situations.[4–7] Studies among pregnant women have linked both natural and technological disasters to negative birth outcomes, including increases in premature delivery rates, birth asphyxia, premature rupture of membranes (PROM), intrauterine growth retardation, and decreased birth weight.[8–10] Associations have also been shown between disasters and social outcomes, including domestic and sexual violence, birth rates, divorce rates, and gender-differential associations with economic losses, workload changes, and postdisaster stress symptoms.[3,9]

The Conservation of Resources (COR) model of stress[11] postulates that people are driven to acquire, preserve, and

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protect that which they value, thereby increasing positive reinforcement. These resources include possessions, personal characteristics, financial resources, social constructs, or anything that aids in acquiring and maintaining the aforementioned resources. The model suggests that any loss of these resources, whether actual or perceived, or failure to gain resources as expected causes psychological distress. Hobfoll [11] characterizes these resources as belonging to four categories: objects (e.g., car, house, furniture), personal characteristics (e.g., knowledge, self-esteem, skills), conditions (e.g., interpersonal relationships, employment, sense of community), and energies (e.g., credit, money, insurance). Disasters such as Hurricane Katrina can cause significant loss from all four resource categories. This can occur through damage to possessions and places of work as well as disruption of established social systems, personal characteristics, and the inability to maintain remaining and gained resources.[12] Additionally, resource loss spirals, or the continued loss of resources, and secondary stressors (additional stressful life events and hassles) are common after disasters.[13]

Hurricane Katrina's impact on New Orleans was unique in that it embodied both a natural disaster (the storm) and a technological/human-made disaster (the failure of the levee system and response to the disaster). The application of COR theory in both natural and technological disaster scenarios has been widely supported. Freedy et al.[14] showed that 2 months after Hurricane Hugo (Charleston, South Carolina, 1989), resource loss predicted psychological distress more strongly than coping behaviors or demographic factors. Freedy et al.[15] later showed that 7 months after the Sierra Madre earthquake of 1991, loss of resources predicted psychological distress better than perceived life threat, stressful life events, and prior traumatic event exposure. In 2000, Smith and Freedy[16] looked specifically at psychosocial resource loss and its effect on both psychological distress and physical symptoms 6 months after the massive 1993 floods in the upper Mississippi valley. They found that flood exposure predicted psychosocial resource loss and went on to show that that resource loss mediated the effects of flood exposure on psychological distress and physical symptoms. Interestingly, Smith and Freedy[16] note that psychosocial resource loss was important even when financial and material losses were high. Arata et al.[17] examined the utility of the COR model in the technological disaster of the Exxon Valdez oil spill (Prince William Sound, Alaska, 1989). They found significant relationships between resource loss—especially conditions and energies resources—and symptoms of anxiety, depression, and posttraumatic stress disorder (PTSD).

None of these studies, however, delineate between the sexes or explore the effects on more specific, vulnerable populations, such as pregnant or postpartum women. Pregnancy and postpartum are considered a time of particular vulnerability to depression because of the challenge of new roles, physical difficulties, hormonal changes, and social isolation.[18] Many of these risk factors, though, are very personal to a woman, and it is not clear if loss of resources due to disaster would have the same effect in this population. A few previous studies shed some light on the subject. Innercity women were found to be more affected by acute than chronic resource loss, and this was not different for pregnant and nonpregnant women.[19] Similarly, loss of resources has been found to predict depression in pregnant and postpartum women.[20,21] Women who gained resources (primarily emotional resources) postpartum after having previously been in a high-loss situation were less prone to depression.[21] This may be relevant to a disaster setting, which is a likely high-loss setting, but postpartum women may gain the satisfactions of motherhood and partially offset that loss.

The goal of this analysis is to assess the influence of loss of resources after disaster on postpartum depression (PPD). We expect that a resource loss and its psychological effect would have been profound, given the large financial, temporal, and emotional investments involved in pregnancy, birth, and infant care on top of the effects of the major disaster. This expectation, combined with the results of previously mentioned studies, led to the hypothesis that overall loss of resources, as well as both tangible/financial and nontangible resource loss, will be associated with PPD. The second objective was to investigate the influence of hurricane experience on depression and compare this with COR predictors. We hypothesize that greater hurricane experience will also be associated with depression and that part of the effect will be due to association with loss of resources.

Materials and Methods

This project is part of the Katrina Moms Study, a longitudinal study of women in southern Louisiana who were pregnant during or directly after Hurricane Katrina. Participants were recruited from Tulane Lakeside Hospital, Metairie, Louisiana, and Women's Hospital, Baton Rouge, Louisiana, after being admitted for childbirth between March 2006 and 2007. During their hospital visit, they completed a recruitment questionnaire containing questions about hurricane experience, social support, and demographics. Participants completed a phone interview at 6–8 weeks postpartum and self-administered, mail-delivered questionnaires at 6 months and 12 months postpartum. If a woman did not return the 12-month questionnaire within a month, she received a reminder phone call. If she still did not return it, a brief questionnaire consisting only of the depression and PTSD scales was sent. Of the 365 women recruited, 208 returned the 6-month questionnaire, 172 returned the 12-month questionnaire, and 48 returned the brief 12-month questionnaire only. Of the 172 full-length and 48 brief 12-month questionnaires returned, 160 had also previously completed the loss of resources (LOR) assessment portion of the 6-month questionnaire. Women who were lost to follow-up were more likely to be black, to have a low income, and to have a high school diploma or less. This analysis includes 208 women who completed the LOR scale and at least one depression assessment at 6 or 12 months. Participants provided demographic data at recruitment, including date of birth, marital status, highest completed grade in school, annual income the year before Katrina, self-classification of race, and number of children. All protocols were approved by the Institutional Review Boards of Tulane University and Woman's Hospital, and all participants provided written informed consent.

Loss of Resources Scale

The LOR scale, a 40-item scale adapted from Freedy by Benight and Harper,[22] was included in the 6-month questionnaire. Before analysis, these questions were divided into tangible and financial factors (tangible LOR), Hobfoll's ener-

gies and objects,[11] and nontangible or psychosocial factors (nontangible LOR), Hobfoll's personal characteristics and conditions (Table 1). Participants indicate the degree to which they have experienced each loss on a scale of 0–4 (0 = no loss, 4 = extreme amount of loss). Scores for the total LOR, tangible LOR, and nontangible LOR scale were calculated by summing the response, giving a maximum tangible LOR score (16 factors) of 64, a maximum nontangible LOR score (23 factors) of 92, and a maximum total LOR score of 156, with a minimum score of 0 for any scale, indicating no loss in any factor. LOR scores were also dichotomized at the mean for a summary variable. Cronbach's alpha was 0.96 for total LOR, 0.91 for tangible LOR, and 0.94 for nontangible LOR.

Hurricane experience score

To assess participants' exposure to the hurricane and its effects, the hurricane experience score (HES) was developed. Based on a previous study of Hurricane Andrew,[23] this scale consists of eight questions including whether participants ever felt their life was in danger, if they or a family member became ill or injured as a result of the storm, if they walked through floodwaters, severity of damage to their home and possessions, if anyone close to them died, or if they witnessed anyone die. These components of danger, injury, and damage have been shown previously to be associated with mental health outcomes.[23–26] We then created a scale of overall severity of hurricane experience by summing the number of events experienced; this approach has been used in several disaster studies.[25] Categories were collapsed and dichotomized at the 90th percentile because of the small sample size and distribution of responses. Experiencing three or more of these items was considered high hurricane experience.

Postpartum depression

The Edinburgh Postnatal Depression Scale (EPDS) was used to assess PPD among the study participants. The 10-question, self-administered scale has a sensitivity of 86% and a specificity of 78%.[27] A score of $\geq$13 was considered depressed.

Analysis

Statistical analyses were conducted using SAS version 9.1 (Cary, NC). The relationships among LOR, HES, and depression were all examined. Bivariate analyses for all categorical variables were conducted using chi-square tests, and mean scores on the LOR scales, which were highly right skewed, were compared using Wilcoxon tests. Regression modeling was performed using log-linear regression for modeling relative risks. LOR scales were examined as continuous and dichotomous variables (dichotomized at the mean). Dichotomous LOR scores are presented for clarity. Age, race, education, parity, and marital status were included as covariates. Income was examined as a confounder, but was no longer an important predictor once the other covariates had been controlled for.

Results

Demographic variables, PPD

A description of the study population is given in Table 2. Within this study population, the mean age was 28.8, and the majority were nonblack (73%), married (64%), and had at least one child prior to the study child (58%); median years of education were 14. At 6 months, 26% met the criteria for depression, and 28% met these criteria at 12 months. Women who identified as a race other than black were less likely to be depressed (21% vs. 38% at 6 months, $p = 0.02$), and married

Table 1. The Loss of Resources Scale

Tangible factors	*Nontangible factors*	
Car	Time for enough sleep	Feeling of being independent
Furniture	Feeling valuable to other people	Companionship with others
Sentimental possessions	Family stability	Feeling that your life has meaning or purpose
Clothing	Free time	Involvement with your church
Pets	A feeling of intimacy with one or more family members	Help with tasks at home
Plants around home	A feeling of intimacy with one or more friends	Loyalty of friends
Tools needed for work	The feeling that you're accomplishing the goals in your life	Help with child care
Adequate food	Time with your loved ones	Involvement in organizations or clubs
Necessary appliances for home	The sense of a daily routine	
The residence you lived in	Health of a family member/friend	
Things needed for your children	Stable employment	
Money for extras	Ability to organize tasks	
Savings or emergency money	Time to do your work	
Adequate income	Understanding from your boss	
Financial credit	Support from co-workers	
Your retirement security	The chance to get more training or education	

Table 2. Description of Katrina Moms Study Population, Southern Louisiana, 2006–2008

Variable	*Completed mental health assessment at 6 months and LOR at 6 months (n = 208)*		*Completed mental health assessment at 12 months and LOR at 6 months (n = 160)*	
	n[a]	%	n	%
Age				
18–22	28	13	17	10
>22–28	61	29	49	30
>28–33	68	33	56	34
>33	51	25	44	27
Race				
White	146	71	123	75
Black	56	27	38	23
Other	4	2	3	2
Education				
<High school	15	8	8	5
High school diploma	42	21	30	19
Some college	53	27	41	26
4-Year college degree	61	31	55	35
>College	29	15	25	16
Parity				
First child	87	42	64	39
Has other children	121	58	102	61
Marital status				
Married	131	64	114	70
Living with partner	37	18	24	15
Separated/divorced	7	3	7	4
Never married	31	15	19	12
Income				
<$20,000	44	22	29	18
$20,000–$60,000	94	47	79	49
>$60,000	62	31	52	33
Smoked before pregnancy				
Yes	32	18	26	17
No	149	82	125	83
Area of residence before hurricane				
New Orleans area	137	66	106	64
Baton Rouge area	71	34	60	36
Number of serious experiences of the hurricane[b] (Hurricane Experience Score)				
3+	34	17	24	15
<3	172	84	140	85

[a]*n* may not add to column head because of missing data.
[b]Serious experiences: fearing for one's life due to the storm, suffering oneself or having a household member or relative suffer an illness/injury, walking in floodwaters, seeing someone die, knowing someone who died, major damage to house.
LOR, loss of resources.

women were less likely to be depressed than unmarried women (19% vs. 32%, $p = 0.02$), but no significant associations were seen with age, education, income, or number of children (data not shown).

Most demographic variables, as well as HES, were significantly associated at the $p < 0.05$ level with the LOR scales (Table 3). HES was also associated with some demographic variables; HES was higher in younger women ($p = 0.06$), black women ($p < 0.01$), low education level ($p < 0.01$), and single women ($p = 0.02$) (data not shown).

LOR scales and HES

All three LOR scales (nontangible LOR, tangible LOR, and the sum of these two) were found to be significantly associated with depression ($p < 0.01$ for all scales at both time points), as was HES ($p < 0.01$). Both tangible and nontangible LOR were associated with depression cross-sectionally—unadjusted relative risk (RR), 2.15, 95% confidence interval (CI), 1.35-3.42, and 3.76 (2.22-6.38), respectively—and prospectively—RR 2.61 (1.58-4.31) and 4.19 (2.34-7.48)). HES was significantly associated with nontangible and tangible LOR scales ($p < 0.01$ for both scales). Additionally, HES was associated with depression—2.19 (1.39–3.45)—at 6 months). A representation of these relationships is shown in Figure 1.

To characterize the interplay of the population's loss of nontangible resources, hurricane experience, and depression at 6 months, study participants were first divided by nontangible LOR (high/low), then by HES (high/low), and finally

Table 3. Demographic Variables and Loss of Resources

Variable	*Tangible/financial loss of resources*				*Nontangible loss of resources*			
	Median	*25th percentile*	*75th percentile*	p	*Median*	*25th percentile*	*75th percentile*	p
Age				0.01				0.09
18–22	11.5	4.0	19.0		15.0	2.5	33.0	
>22–28	17.0	4.0	30.0		21.0	7.0	37.0	
>28–33	5.0	0.0	15.5		11.5	2.0	24.0	
>33	7.0	1.0	19.0		10.0	3.0	30.0	
Race				<0.01				<0.01
White	5.0	0.0	17.0		9.5	1.0	24.0	
Black	23.0	12.5	35.5		33.5	14.5	47.5	
Other	3.0	0.2	12.0		5.5	3.0	10.2	
Education				<0.01				<0.01
High school diploma or less	15.0	4.0	29.0		20.0	4.0	36.0	
Some college/associates degree	15.0	4.0	26.0		18.0	7.0	36.0	
College degree or more	3.5	0.0	14.0		7.5	1.0	22.0	
Parity				0.02				0.12
First child	5.0	1.0	17.0		12.0	3.0	24.0	
Has other children	13.0	1.0	27.0		20.0	2.0	36.0	
Partnership status				<0.01				<0.01
Married/living with partner	6.0	1.0	20.0		11.0	2.0	30.0	
Never married or separated/divorced	19.0	13.0	29.0		24.0	13.0	49.0	
Area of residence before hurricane				<0.01				<0.01
New Orleans area	14.0	4.0	29.0		18.0	6.0	36.0	
Baton Rouge area	3.0	0.0	9.0		5.0	0.0	21.0	
Number of serious experiences of the hurricane[a] (Hurricane Experience Score)				<0.01				<0.01
3+	25.5	11.0	39.0		36.5	16.0	53.0	
<3	6.0	1.0	18.5		11.0	2.0	24.5	

[a]Serious experiences: fearing for one's life due to the storm, suffering oneself or having a household member or relative suffer an illness/injury, walking in floodwaters, seeing someone die, knowing someone who died, major damage to house.

by depression status (depressed/not depressed) (Table 4). Both loss and hurricane experience were individually associated with increased risk of depression. Among those with high nontangible LOR, 46% were depressed compared with 12.2% of those in the low nontangible LOR category. Further, among those with high nontangible LOR and a high HES, 52.4% were depressed, whereas among participants with high nontangible LOR but low HES, 28.6% were depressed. Analogous findings were present in the low non-tangible LOR category (Table 4). Results were similar at 12 months (data not shown).

At 6 months, HES and nontangible LOR remained significant predictors, but tangible LOR did not predict depression. At 12 months, similar results were found, even after controlling for depression score at 6 months (Table 5). HES continued to predict mental health after LOR was accounted for, but the risk estimate declined, suggesting that LOR might mediate some of the effect. In all models, no multiplicative interaction between HES and nontangible LOR was noted, indicating independent effects on depression.

Discussion

In our study, LOR predicted depression, as hypothesized. After regression modeling, however, only nontangible LOR remained significantly associated with depression. Although tangible LOR alone is associated with depression, this association may be largely mediated by nontangible LOR either (1) as an intermediate in the relationship (tangible loss leading to nontangible loss leading to depression) or (2) by psychosocial factors affecting perceived or actual loss of tangible resources.

The hypothesis of HES being associated with depression was supported. Moreover, it was shown that HES was also

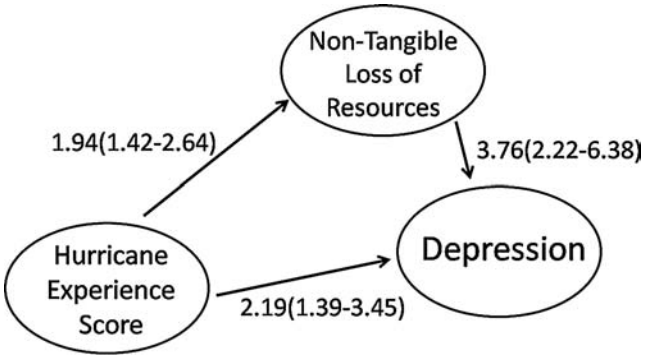

FIG. 1. Visual representation of depression prediction construct.

Table 4. Combined Effects of Loss of Resources and Hurricane Experience on Depression After Hurricane Katrina

Nontangible loss of resources	*Hurricane experience*	*Depression*	*Frequency* n *(%)*	*% Depressed*	*% Depressed*
High loss	High hurricane experience	Depressed	33 (15.94)	52.4	46.4
		Not depressed	30 (14.49)		
	Low hurricane experience	Depressed	6 (2.90)	28.6	
		Not depressed	15 (7.25)		
Low loss	High hurricane experience	Depressed	10 (4.83)	20.0	12.2
		Not depressed	40 (19.32)		
	Low hurricane experience	Depressed	5 (2.42)	6.8	
		Not depressed	68 (32.85)		

associated with LOR (all scales), confirming previous studies that have suggested disaster exposure directly leads to loss of psychosocial resources.[16] Nontangible LOR and HES had independent effects but not a synergistic effect on depression. As expected, having high nontangible LOR and high HES yielded the highest depression rates. Notably, having high nontangible LOR and low HES together yields higher depression rates than having low nontangible LOR but high HES. This points to nontangible LOR as explaining a larger portion of depression than does HES, which is confirmed by the regression models. It also suggests that low LOR may mitigate the effects of a high-loss situation. A previous study of COR in postpartum women[21] found that most of the resources gained after birth were nontangible, such as meaning, sense of pride, and positive feelings about oneself. Rates of depression in this study were not particularly high for a postpartum sample or a disaster sample,[28] and it is possible that for many women, the increased positive resources associated with becoming a mother helped make up psychologically for the other resources lost in the storm. Interestingly, when we asked women to name one good thing that had come out of the storm, the single most popular answer was getting pregnant or the baby.

We also found that black women, women in their mid-20s, and those with less than a college degree were more likely to report high loss of resources. These results are consistent with previous research in PPD, which indicates that younger, unmarried, nonwhite, and less educated mothers experienced a higher prevalence of PPD.[29] These authors also noted higher prevalence of PPD among mothers who experienced traumatic or financial stress during pregnancy.

There are several limitations to this study. One is the high rate of loss to follow-up. In part because of the substantial residential mobility in post-Katrina New Orleans, of the 365 women who completed recruitment questionnaires, 208 women completed 6-month surveys (57%); those who were lost to follow-up may have a different risk for depression. Furthermore, because the study participants were recruited post-Katrina and because of the scattered pre-Katrina population, it is not feasible to compare the study population to those who evacuated or left following the storm and never returned. There may be differences between the study population and pregnant women who decided not to return to the area. Our sample is generally older, more educated, and more likely to be married than the overall population of women giving birth in the region, according to 2006 vital statistics data. Women completed the LOR questionnaire at least 9 months post-Katrina and in many cases up to 18 months later; it is possible that a different time frame would yield different results—for instance, a greater focus on tangible losses. Also, it is likely that depressed individuals perceive their resources differently from nondepressed individuals, although the continued association with depression 12 months later, even after controlling for depressive symptoms at 6 months, argues that this does not explain the whole relationship.

In conclusion, nontangible psychosocial resource loss, but not tangible and financial loss of resources, was shown to predict psychological outcomes in postpartum women after disasters. Psychological outcomes after natural disasters have been researched previously, but to our knowledge, no such study has applied the COR theory to the vulnerable population of postpartum women. Although overall depression rates

Table 5. Multiple Regression Models of Postpartum Depression After Hurricane Katrina

	6 months			*12 months*					
	RR[a]	*95% CI*	p	*RR*[a]	*95% CI*	p	*RR*[b]	*95% CI*	p
Nontangible LOR	3.94	2.18-7.13	<0.01	3.65	1.77-7.49	<0.01	2.14	1.07-4.24	0.03
Tangible/financial LOR	0.99	0.59-1.67	0.69	0.97	0.52-1.79	0.91	0.86	0.43-1.69	0.66
High hurricane experience[c]	1.64	1.02-2.62	0.04	2.00	1.26-3.19	<0.01	1.47	0.95-2.27	0.09

[a]Model includes nontangible LOR, tangible/financial LOR, hurricane experience, age, race, education, parity, marital status.
[b]Model includes above variables as well as depression score at 6 months.
[c]High hurricane experience, 3 or more serious experiences of the storm.
RR, relative risk; CI, confidence interval; LOR, loss of resources.

were not high for a postpartum sample, the burdens of pregnancy, childbirth, and infant care represent secondary stressors that could lead to a resource loss spiral, as suggested by Sattler et al.[13] Future studies should examine the interrelationship between resources gained and resources lost as a result of pregnancy and motherhood and their influence on depression. In addition, future studies of mental health after disaster should include examination of pregnant and postpartum women's health.

Hurricane experience was shown to be predictive of loss of resources and to contribute to depression independently of nontangible resource loss. The study concurs with previous research and supports the COR model, suggesting nontangible loss of resources and disaster experience play a large role in psychological distress. This research suggests that interventions that focus on restoring psychosocial resources, rather than just restoring tangible possessions and financial status, could reduce the lasting psychological impact of disasters, such as Hurricane Katrina. From a public health perspective, the lasting effects of disaster are likely to be felt through this loss of nontangible resources rather than loss of objects, and the focus of both planning and response should be on protecting and addressing those needs.

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Disclosure Statement

The authors have no conflicts of interest to report.

References

1. U.S. Bureau of the Census. Census Bureau estimates nearly 10 million residents along Gulf Coast hit by Hurricane Katrina. U.S. Census Bureau News, 2005.
2. Graumann A, Houston T, Lawrimore J, et al. Hurricane Katrina: A climatological pespective. Technical Report 2005–01. Asheville, NC: NOAA National Climactic Data Center, 2005.
3. WHO. Gender and health in disasters. 2002 Available at www.who.int/gender/other_health/en/genderdisasters.pdf
4. Al Gasseer N, Dresden E, Keeney GB, Warren N. Status of women and infants in complex humanitarian emergencies. J Midwifery Womens Health 2004;49:7–13.
5. Callaghan WM, Rasmussen SA, Jamieson DJ, et al. Health concerns of women and infants in times of natural disasters: Lessons learned from Hurricane Katrina. Matern Child Health J 2007;11:307–311.
6. Marcus SM. Depression during pregnancy: Rates, risks and consequences. Can J Clin Pharmacol 2008;16:e15–e22.
7. Sjostrom H, Langius-Eklof A, Hjertberg R. Well-being and sense of coherence during pregnancy. Acta Obstet Gynecol Scand 2004;83:1112–1118.
8. Eskenazi B, Marks AR, Catalano R, Bruckner T, Toniolo PG. Low birthweight in New York city and upstate New York following the events of September 11th. Hum Reprod 2007; 22:3013–3020.
9. Enarson E. Gender issues in natural disasters: Talking points and research needs. Paper prepared for the International Labour Organization High-Level Research Consultation for the InFocus Programme on Crisis Response and Reconstruction Workshop. Geneva, May 2000. www.gdnonline.org/resources/ilo-talking.doc. Last accessed March 3, 2010.
10. Neuberg M, Pawlosek W, Lopuszanski M, Neuberg J. [The analysis of the course of pregnancy, delivery and postpartum among women touched by flood disaster in Kotlin Klodzki in July 1997.] Ginekol Pol 1998;69:866–870.
11. Hobfoll SE. Conservation of resources. A new attempt at conceptualizing stress. Am Psychol 1989;44:513–524.
12. Freudenberg WR, Jones TR. Attitudes and stress in the presence of technological risks: Towards a psychological perspective. Social Forces 1991;69:1143–1168.
13. Sattler DN, Preston AJ, Kaiser CF, et al. Hurricane Georges: A cross-national study examining preparedness, resource loss, and psychological distress in the U.S. Virgin Islands, Puerto Rico, Dominican Republic, and the United States. J Trauma Stress 2002;15:339–350.
14. Freedy JR, Shaw DL, Jarrell MP, Masters CR. Towards an understanding of the psychological impact of natural disasters: An application of the conservation resources stress model. J Trauma Stress 1992;5:441–454.
15. Freedy JR, Saladin ME, Kilpatrick DG, Resnick HS, Saunders BE. Understanding acute psychological distress following natural disaster. J Trauma Stress 1994;7:257–273.
16. Smith BW, Freedy JR. Psychosocial resource loss as a mediator of the effects of flood exposure on psychological distress and physical symptoms. J Trauma Stress 2000;13:349–357.
17. Arata CM, Picou JS, Johnson GD, McNally TS. Coping with technological disaster: An application of the conservation of resources model to the Exxon Valdez oil spill. J Trauma Stress 2000;13:23–39.
18. Runquist JJ. A depressive symptoms responsiveness model for differentiating fatigue from depression in the postpartum period. Arch Womens Ment Health 2007;10:267–275.
19. Ennis NE, Hobfoll SE, Schroeder KEE. Money doesn't talk, it swears: How economic stress and resistance resources impact inner-city women's depressive mood. Am J Community Psychol 2000;28:149–173.
20. Wells JD, Hobfoll SE, Lavin J. Resource loss, resource gain, and communal coping during pregnancy among women with multiple roles. Psychol Women Q 1997;21:645–662.
21. Wells JD, Hobfoll SE, Lavin J. When it rains, it pours: The greater impact of resource loss compared to gain on psychological distress. Pers Soc Psychol Bull 1999;25:1172–1182.
22. Benight CC, Harper ML. Coping self-efficacy perceptions as a mediator between acute stress response and long-term distress following natural disasters. J Trauma Stress 2002;15:177–186.
23. Norris FH, Perilla JL, Riad JK, Kaniasty K, Lavizzo EA. Stability and change in stress, resources, and psychological morbidity: Who suffers and who recovers: Findings from Hurricane Andrew. Anxiety Stress Coping 1999;12:363–396.
24. Armenian HK, Morikawa M, Melkonian AK, et al. Loss as a determinant of PTSD in a cohort of adult survivors of the 1988 earthquake in Armenia: Implications for policy. Acta Psychiatr Scand 2000;102:58–64.
25. Ironson G, Wynings C, Schneiderman N, et al. Posttraumatic stress symptoms, intrusive thoughts, loss, and immune function after Hurricane Andrew. Psychosom Med 1997;59:128–141.
26. Norris FH, Kaniasty K. Received and perceived social support in times of stress: A test of the social support deterioration deterrence model. J Pers Soc Psychol 1996;71:498–511.

27. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry 1987;150:782–786.
28. Harville EW, Xiong X, Pridjian G, Elkind-Hirsch K, Buekens P. Postpartum mental health after Hurricane Katrina: A cohort study. BMC Pregnancy Childbirth 2009;9: 21.
29. Brett K, Barfield W, Williams C. Prevalence of self-reported postpartum depressive symptoms—17 states, 2004–2005. MMWR 2008;57:361–366.

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