ORIGINAL RESEARCH

Correlation Between the Great East Japan Earthquake and Postpartum Depression: A Study in Miyako, Iwate, Japan

Hidekazu Nishigori, MD, PhD; Michiho Sasaki, BSN; Taku Obara, PhD; Toshie Nishigori, PhD; Mami Ishikuro, PhD; Hirohito Metoki, MD, PhD; Junichi Sugawara, MD, PhD; Shinichi Kuriyama, MD, PhD; Akira Hosoyachi, MD; Nobuo Yaegashi, MD, PhD; Takashi Kobayashi, MD; Noboru Yoshizumi, MD, PhD

ABSTRACT

Objective: This study aimed to explore the correlation between the 2011 Great East Japan Earthquake and postpartum depression among perinatal subjects in the Miyako region of Iwate, an area damaged by earthquakes and tsunamis.

Methods: We retrospectively compared the percentages of women with scores ≥9 on the Japanese version of the Edinburgh Postnatal Depression Scale (EPDS) among 3 groups of women who gave birth prior to the disaster (before-disaster group: n = 141), within 3 months after the disaster (within-3-months group: n = 70), and 4-6 months after the disaster (4-6-months group: n = 89) at the Iwate Prefectural Miyako Hospital. The risk factors for EPDS scores ≥9 were estimated with multivariate logistic regression analyses.

Results: Compared with the before-disaster group, a significantly greater number of women in the within-3-months group had EPDS scores ≥9 at hospital discharge (31.4% versus 9.9%, $P < .0001$), whereas women in the 4-6-months group did not (10.1% versus 9.9%, $P = .96$). In both the after-disaster groups, the destruction of their home (adjusted odds ratio [AOR], 3.68; 95% confidence interval [CI], 1.46-9.26) and dissatisfaction with their living conditions (AOR, 3.02; 95% CI, 1.20-7.59) were significantly associated with EPDS scores ≥9.

Conclusions: An increase in postpartum depression was observed after the Great East Japan Earthquake among perinatal women. (*Disaster Med Public Health Preparedness.* 2015;9:307-312)

Key Words: tsunamis, mental disorders, medical records

On March 11, 2011, an undersea earthquake (the Great East Japan Earthquake) measuring 9.0 on the Richter scale hit the northeast coast of Honshu Island, Japan. Its epicenter was located approximately 130 km east of the Pacific coast (Figure 1). The earthquake generated devastating tsunamis with waves that reached heights of 40 m. The tsunamis destroyed the towns and villages in the coastal areas of a number of prefectures, including the Iwate, Miyagi, and Fukushima prefectures. Approximately 18 400 people died or went missing, and more than 400 000 houses and buildings were completely or partially destroyed.[1]

Previous studies have suggested that maternal mental health disorders, including perinatal depression, can be influenced by the devastation caused by a natural disaster.[2-5] Perinatal depression can affect the mental health of postnatal women[6] and may impact the quality of care given to the newborn.[7] Maternal psychosocial health can affect the mother-infant relationship,[8-10] the nutritional status of the infants, illness,[11,12] and children's emotional or cognitive problems.[13,14] Therefore, perinatal women should be considered to be a vulnerable population, and methods to prevent perinatal depression must be established in preparation of future devastating disasters.

The Iwate Prefectural Miyako Hospital is located on the northeastern coast of Japan (Figure 1), and its medical service area includes Miyako, Iwaizumi, Yamada, and Tanohata. According to 2010 census data, this area has a population of approximately 92 000, and approximately 550 births occur annually. Approximately 390 births annually occur at the Iwate Prefectural Miyako Hospital. Following the Great East Japan Earthquake and tsunamis, approximately 1500 people died or went missing and more than 12 600

https://doi.org/10.1017/dmp.2015.51 Published online by Cambridge University Press

FIGURE 1

Location of Miyako, Iwate Prefecture

The epicenter of the Great East Japan Earthquake is schematically (cross mark) indicated.

houses and buildings were completely or partially destroyed in the service area. Following this disaster, the Iwate Prefectural Miyako Hospital served as a disaster base hospital, and it provided intensive maternal mental health care to prevent perinatal depression.

In the present study, we retrospectively examined scores on the Japanese version of the Edinburgh Postnatal Depression Scale (EPDS)[15,16] of perinatal women who were treated at the Iwate Prefectural Miyako Hospital to assess the influence of the Great East Japan Earthquake on their mental health.

METHODS

Study Design

This retrospective study was conducted using a medical chart–based survey and a questionnaire that was completed by perinatal women who gave birth at the Iwate Prefectural Miyako Hospital. Existing medical records were reviewed in this observational study. Because this was a retrospective study, informed consent was omitted according to the Ethical Guidelines for Clinical Studies issued by the Japanese Ministry of Health, Labour, and Welfare.[17] The study protocol was approved by the ethics committee of the Iwate Prefectural Miyako Hospital on January 17, 2012, and conformed to the provisions of the Declaration of Helsinki (revised in Tokyo 2004).[18]

Study Subjects

The study subjects included perinatal women who had delivered at the Iwate Prefectural Miyako Hospital between October 1, 2010, and September 10, 2011. The hospital had been assessing these patients with the Japanese version of EPDS[15,16] at the time of postdelivery hospital discharge and their regular 1-month postdelivery checkup. Perinatal women who gave birth between February 10, 2011, and March 10, 2011, were excluded because they had undergone the hospital discharge EPDS test prior to the earthquake and the 1-month EPDS test after the earthquake.

Data Collection

We collected the following data from medical charts: age, marital status, parity, employment, mental disorder history, obstetric complications during pregnancy (ie, threatened premature labor, preterm delivery, pregnancy-induced hypertension, fetal growth restriction, hemolysis, elevated liver enzymes, low platelet count syndrome, placenta previa, placental abruption, placenta accreta, gestational diabetes, or intrauterine fetal death), type of delivery, abnormal delivery (emergency cesarean section, vacuum extraction, obstructed labor, or uterine atony), postpartum obstetric complications (vulvar hematoma, problematic surgical scaring, or breast abnormalities), and scores on the Japanese version of the EPDS at hospital discharge and at the regular checkup 1 month after delivery.

Women with vaginal deliveries took the EPDS test 4-5 days later at the time of hospital discharge, whereas those who delivered by cesarean section took the test 6-7 days later at the time of hospital discharge. At the Iwate Miyako Prefectural Hospital, women are routinely admitted for 4-5 days after uncomplicated vaginal deliveries and for 6-7 days after cesarean deliveries.

The Japanese version of EPDS is a self-reported scale that contains 10 items, each of which is graded with a 4-point Likert scale, with the total score ranging from 0 to 30. The cutoff score in the Japanese population is 9, which is considered to indicate a significant risk for postpartum depression.[16,19] The self-administered questionnaire administered at hospital discharge after delivery included questions about whether perinatal women could consult their families when they had problems, anxiety over household finances, dissatisfaction with living conditions, the death of loved ones, and worries about baby care.

We collected information on the feelings of the women who gave birth after March 11, 2011, about being a disaster victim, the destruction of their homes, residence issues, and family members who had lost their jobs. The definition of a destroyed home was in accordance with the guidelines authorized by the Cabinet Office of the Japanese Government in 2011.[20]

Analysis

The percentages of women with EPDS scores ≥9 at hospital discharge and 1 month after delivery were compared among

https://doi.org/10.1017/dmp.2015.51 Published online by Cambridge University Press

the following 3 groups: the before-disaster group, which consisted of women who gave birth before the disaster (October 1, 2010-February 9, 2011); the within-3-months group, which consisted of women who gave birth within 3 months after the disaster (March 11, 2011-June 10, 2011); and the 4-6-months group, which consisted of women who gave birth 4-6 months after the disaster (June 11, 2011-September 10, 2011). Student's t tests, χ^2 tests, and Fisher's tests were used when appropriate for statistical analyses.

Multivariate logistic regression analyses were performed after adjusting for the variables that were significantly associated with EPDS scores ≥9 at hospital discharge among the after-disaster group in univariate analysis. The after-disaster group included both the within-3-months group and the 4-6-months group. The adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were calculated to estimate the risk of EPDS scores ≥9 at hospital discharge after the disaster. All statistical analyses were performed with SAS version 9.3 statistical software (SAS Institute, Inc, Cary, NC).

RESULTS

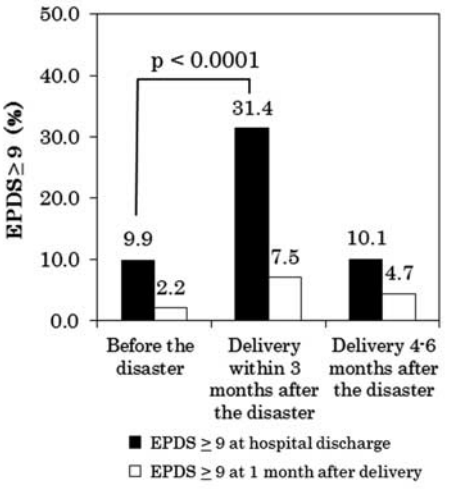
Of the 141 women in the before-disaster group, 141 and 134 underwent the EPDS test at the time of discharge and 1 month after delivery, respectively. Of the 73 women in the within-3-months group, 70 and 67 underwent the EPDS test at hospital discharge and 1 month after delivery, respectively. Of the 90 women in the 4-6-months group, 89 and 86 underwent the EPDS test at hospital discharge and 1 month after delivery, respectively.

Comparisons of the percentages of women with EPDS scores ≥9 at hospital discharge and 1 month after delivery are shown in Figure 2. The percentage of women with EPDS scores ≥9 at hospital discharge was significantly greater in the within-3-months group (31.4%, $P < .0001$) than in the before-disaster group (9.9%); this difference was not significant 1 month after delivery (7.5% versus 2.2%, $P = .12$). There was no significant difference in the percentages of women with EPDS scores ≥9 between the 4-6-months group and before-disaster group at hospital discharge (10.1% versus 9.9%, $P = .96$) or 1 month after delivery (4.7% versus 2.2%, $P = .44$).

The background characteristics of the perinatal women who took the EPDS test at hospital discharge in the before-disaster group and in the after-disaster group are shown in Table 1. In the after-disaster group, univariate analysis showed that the percentages of women with obstetric complications during pregnancy ($P = .03$), dissatisfaction with living conditions ($P = .0001$), the death of loved ones ($P = .048$), the destruction of their home ($P < .0001$), and a change in residence after the disaster ($P = .0001$) were significantly different between the group with EPDS scores ≥9 and the group with scores <9 (Table 1). Because the correlation between the destruction of their home and a change in residence after the disaster was multicollinear, we chose the former variable for multivariate logistic regression analysis. Multivariate logistic regression analysis was adjusted for obstetric complications during pregnancy, the death of loved ones, dissatisfaction with living conditions, and the destruction of their home. This analysis showed that the destruction of their home (AOR, 3.02; 95% CI, 1.20-7.59) and dissatisfaction with living conditions (AOR, 3.68; 95% CI, 1.46-9.26) were significantly and independently associated with EPDS scores ≥9 at hospital discharge after the disaster (Table 2).

FIGURE 2

Percentages of Women With Scores ≥9 on the Japanese Version of the Edinburgh Postnatal Depression Scale (EPDS) at Hospital Discharge and 1 Month After Delivery



DISCUSSION

The percentage of women with EPDS scores ≥9 at hospital discharge was significantly greater in the within-3-months group than in the before-disaster group ($P < .0001$). This difference was not significant ($P = .12$) 1 month after delivery. Several explanations for this finding have been proposed. First, an increase in the number of patients with perinatal depression after the disaster was predicted; therefore, the hospital conducted a recollection of birth (birth review)[21,22] earlier and introduced touch[23,24] to encourage patients to express their emotions. Second, because damage to parenting environments such as housing without essential

https://doi.org/10.1017/dmp.2015.51 Published online by Cambridge University Press

https://doi.org/10.1017/dmp.2015.51 Published online by Cambridge University Press

TABLE 1

Background Characteristics of Perinatal Women Who Underwent the Japanese Version of the Edinburgh Postnatal Depression Scale (EPDS) at Hospital Discharge

		Before-Disaster Group				After-Disaster Group[a]			
		Total	EPDS < 9	EPDS ≥ 9		Total	EPDS < 9	EPDS ≥ 9	
	n	141	127	14	*P*	159	128	31	*P*
Age	Mean ± SD	30.1 ± 5.6	30.1 ± 5.5	29.8 ± 6.1	.83	30.3 ± 5.6	30.3 ± 5.7	30.0 ± 5.2	.74
	≤24 y, n (%)	21 (14.9)	18 (14.2)	3 (21.4)	.40	26 (16.4)	20 (15.6)	6 (19.4)	.56
	25–29 y, n (%)	46 (32.6)	42 (33.1)	4 (28.6)		45 (28.3)	36 (28.1)	9 (29.0)	
	30–34 y, n (%)	42 (29.8)	40 (31.5)	2 (14.3)		47 (29.6)	36 (28.1)	11 (35.5)	
	≥35 y, n (%)	32 (22.7)	27 (21.3)	5 (35.7)		41 (25.8)	36 (28.1)	5 (16.1)	
Marital status	Married, n (%)	140 (99.3)	126 (99.2)	14 (100.0)	1.00	152 (95.6)	122 (95.3)	30 (96.8)	1.00
Parity	Primipara, n (%)	60 (42.6)	53 (41.7)	7 (50.0)	.55	66 (41.5)	51 (39.8)	15 (48.4)	.39
	Multipara, n (%)	81 (57.5)	74 (58.3)	7 (50.0)		93 (58.5)	77 (60.2)	16 (51.6)	
Employment	Yes, n (%)	65 (46.1)	58 (45.7)	7 (50.0)	.76	61 (38.4)	49 (38.3)	12 (38.7)	.96
Mental disorder history	Yes, n (%)	11 (7.8)	11 (8.7)	0 (0.0)	.60	3 (1.9)	1 (0.8)	2 (6.5)	.10
Complication during pregnancy	Yes, n (%)	35 (24.8)	27 (21.3)	8 (57.1)	.01	26 (16.4)	17 (13.3)	9 (29.0)	.03
Type of delivery	Spontaneous vaginal delivery, n (%)	92 (65.3)	84 (66.1)	8 (57.1)	.56	96 (60.4)	74 (57.8)	22 (71.0)	.08
	Vacuum extraction, n (%)	0 (0.0)	0 (0.0)	0 (.0)		8 (5.0)	5 (3.9)	3 (9.7)	
	Cesarean section, n (%)	49 (34.8)	43 (33.9)	6 (42.9)		55 (34.6)	49 (38.3)	6 (19.4)	
Abnormal delivery	Yes, n (%)	17 (12.1)	14 (11.0)	3 (21.4)	.38	28 (17.6)	21 (16.4)	7 (22.6)	.42
Complication at postpartum	Yes, n (%)	1 (0.7)	1 (0.8)	0 (0.0)	1.00	5 (3.1)	4 (3.1)	1 (3.2)	1.00
Family who can consult	No, n (%)	7 (5.0)	4 (3.2)	3 (21.4)	.02	4 (2.5)	2 (1.6)	2 (6.5)	.17
Anxiety over household finances	Yes, n (%)	28 (19.9)	24 (18.9)	4 (28.6)	.48	23 (14.5)	18 (14.1)	5 (16.1)	.78
Satisfaction with living conditions	No, n (%)	28 (19.9)	23 (18.1)	5 (35.7)	.12	47 (29.6)	29 (22.7)	18 (58.1)	.0001
Death of loved ones	Yes, n (%)	24 (17.0)	21 (16.5)	3 (21.4)	.71	53 (33.3)	38 (29.7)	15 (48.4)	.048
Worries about baby care	Yes, n (%)	51 (36.2)	20 (24.7)	31 (51.7)	.001	55 (34.6)	28 (30.1)	27 (40.9)	.16
Destruction of home	Complete (carried away), n (%)					15 (9.4)	7 (5.5)	8 (25.8)	.001
	Complete, n (%)					9 (5.7)	6 (4.7)	3 (9.7)	
	Half, n (%)					8 (5.0)	5 (3.9)	3 (9.7)	
	Partial, n (%)					2 (1.3)	1 (0.8)	1 (3.2)	
	No damage, (%)					125 (78.6)	109 (85.2)	16 (51.6)	
	Total destroyed, n (%)					34 (21.4)	19 (14.8)	15 (48.4)	<.0001
Residence	Refuge, n (%)					2 (1.3)	0 (0.0)	2 (6.5)	<.0001
	Temporary dwelling, n (%)					8 (5.0)	7 (5.5)	1 (3.2)	
	Parent's house, n (%)					9 (5.7)	7 (5.5)	2 (6.5)	
	Relative's house, n (%)					6 (3.8)	2 (1.6)	4 (12.9)	
	House or apartment for rent, n (%)					4 (2.5)	1 (0.8)	3 (9.7)	
	Damaged/destroyed own house, n (%)					7 (4.4)	4 (3.1)	3 (9.7)	
	Own house, n (%)					123 (77.4)	107 (83.6)	16 (51.6)	
	Change of residence by disaster, n (%)					36 (22.6)	21 (16.4)	15 (48.4)	.0001
Family who lost job	Partner, n (%)					11 (6.9)	8 (6.3)	3 (9.7)	.82
	Subject, n (%)					1 (0.6)	1 (0.8)	0 (0.0)	
	Other, n (%)					1 (0.6)	1 (0.8)	0 (0.0)	
	None, n (%)					146 (91.8)	118 (92.2)	28 (90.3)	
	Total who lost job, n (%)					13 (8.2)	10 (7.8)	3 (9.7)	.72

[a]The after-disaster group included both the within-3-months group and the 4-6-months group.

TABLE 2

Multivariate Logistic Regression Analysis of the Data for Perinatal Women With Scores ≥9 on the Japanese Version of the EPDS Score at Hospital Discharge in the After-Disaster Group

Variables	β	SE	AOR (95% CI)[a]	P
Obstetric complications during pregnancy (no = 0)	0.71	0.525	2.03 (0.73–5.67)	.18
Death of loved ones (no = 0)	0.19	0.469	1.21 (0.48–3.04)	.68
Dissatisfaction with living conditions (satisfaction = 0)	1.10	0.470	3.02 (1.20–7.59)	.02
Destruction of their home (no = 0)	1.30	0.471	3.68 (1.46–9.26)	.006
Change in residence after the disaster (no = 0)[b]			—	

Abbreviations: EPDS, Edinburgh Postnatal Depression Scale; SE, standard error; AOR, adjusted odds ratio; CI, confidence interval.
[a]Adjusted for "obstetric complications during pregnancy," "death of loved ones," "dissatisfaction with living conditions," and "destruction of their home."
[b]The correlation between "destruction of their home" and "change in residence after the disaster" was multicollinear.

utilities was expected, the hospital provided support to promote breastfeeding and advised new mothers about the level of damage at the time of discharge, and they received parenting support at hospital discharge and at checkups performed 2 weeks and 1 month after delivery. Although the difference of 1 month after delivery was not significant (5 of 67 versus 3 of 134, $P = .12$), the study was statistically limited because the number of clinical cases was small. Therefore, the results must be interpreted with caution.

There were no significant differences between the 4-6-months group and the before-disaster group at hospital discharge (10.1% versus 9.9%, $P = .96$) and 1 month after delivery (4.7% versus 2.2%, $P = .44$). The prevalence of EPDS scores ≥9 at the Iwate Prefectural Miyako Hospital differed from the findings of a study that was conducted in the coastal area of Miyagi Prefecture after the disaster.[2] Miyagi Prefecture is located to the south of Iwate Prefecture (Figure 1). In the coastal area of Miyagi Prefecture, which was also affected by the disaster,[25,26] the percentage of postpartum women with EPDS scores ≥9 was 21.3% around 6 months after the disaster.[2] Further investigations are required to clarify the factors correlated with this difference.

Multivariate logistic regression analyses were performed in the after-disaster group with EPDS scores ≥9 at hospital discharge. Because the number of clinical cases was small in multivariate logistic regression analyses in the within-3-months group and in the 4-6-months group separately, the after-disaster group included both the within-3-months group and the 4-6-months group for multivariate logistic regression analyses. For the risk factors for perinatal depression that were related to the disaster, previous studies have found that exposure to storm,[27] loss of resources,[28] earthquake experience,[29,30] anxiety about earthquakes,[31,32] and exposure to tsunami[2] were more likely to cause depression in pregnant and postnatal women who were affected by natural disasters. In the present study, we found that the destruction of their home and dissatisfaction with their living conditions were significant risk factors for postpartum depression among women in the after-disaster group.

Limitations

This study had some limitations. First, this study was based on a single institution, which decreases the generalizability of the results. There were 2 obstetric clinics other than the Iwate Miyako Prefectural Hospital in the region, and this study did not include all perinatal women in the Miyako medical service area. Second, this study did not investigate the impact of "maternity blues" on the results. Third, the study also had statistical and epidemiological limitations because the number of clinical cases was small.

CONCLUSIONS

In conclusion, the percentage of women with EPDS scores ≥9 at hospital discharge was significantly greater in the group that delivered within 3 months after the Great East Japan Earthquake than in the group that delivered before the disaster. The destruction of their home and dissatisfaction with living conditions were more likely to cause perinatal depression in women who delivered after the disaster. An increase in postpartum depression is predicted after a large-scale disaster, and interventions focused on pregnant women should be actively initiated after the disaster.

About the Authors

Department of Obstetrics and Gynecology, Tohoku University Graduate School of Medicine, Miyagi, Japan (Drs H. Nishigori, Sugawara, and Yaegashi); Department of Obstetrics and Gynecology, Iwate Prefectural Miyako Hospital, Iwate, Japan (Ms Sasaki and Drs Hosoyachi and Yoshizumi); Tohoku Medical Megabank Organization (Drs Obara, T. Nishigori, Ishikuro, Metoki, Sugawara, Kuriyama, and Yaegashi)and International Research Institute of Disaster Science, (Dr Kuriyama), Tohoku University, Miyagi, Japan; and Kobayshi Clinic of Obstetrics and Gynecology, Iwate, Japan (Dr Kobayashi).

Correspondence and reprint requests to Hidekazu Nishigori, MD, PhD, Department of Obstetrics and Gynecology, Tohoku University Graduate School of Medicine, 1-1 Seiryo Aoba, Sendai, Miyagi, Japan, 020-8505 (e-mail: nishigori@med.tohoku.ac.jp).

Acknowledgments

We thank Dr Hideyuki Chida, Dr Hideo Kodama, Dr Takeshi Obara, Mrs Toshiko Kurabe, and Dr Yoshihiro Akimoto for their expertise and guidance. This work was supported by JSPS KAKENHI (C) Grant Number 24592457

Published online: April 21, 2015.

https://doi.org/10.1017/dmp.2015.51 Published online by Cambridge University Press

REFERENCES

1. Countermeasures for the Great East Japan Earthquake; damage situation and police countermeasures associated with 2011. Tohoku District—off the Pacific Ocean Earthquake [in Japanese]. The National Police Agency website. https://www.npa.go.jp/archive/keibi/biki/index_e.htm. Accessed October 10, 2014.
2. Nishigori H, Sugawara J, Obara T, et al. Surveys of postpartum depression in Miyagi, Japan, after the Great East Japan Earthquake. *Arch Womens Ment Health*. 2014;17:579-581.
3. Ren JH, Chiang CL, Jiang XL, et al. Mental disorders of pregnant and postpartum women after earthquakes: a systematic review. *Disaster Med Public Health Prep*. 2014;8:315-325.
4. Harville EW, Xiong X, Pridjian G, et al. Postpartum mental health after Hurricane Katrina: a cohort study. *BMC Pregnancy Childbirth*. 2009;9:21.
5. Chang HL, Chang TC, Lin TY, et al. Psychiatric morbidity and pregnancy outcome in a disaster area of Taiwan 921 earthquake. *Psychiatry Clin Neurosci*. 2002;56:139-144.
6. Sayil M, Gure A, Ucanok Z. First time mother's anxiety and depressive symptoms across the transition to motherhood: associations with maternal and environmental characteristics. *Women Health*. 2006;44:61-77.
7. Murray L, Fiori-Cowley A, Hooper R, et al. The impact of postnatal depression and associated adversity on early mother-infant interactions and later infant outcome. *Child Dev*. 1996;67:2512-2526.
8. Kokubu M, Okano T, Sugiyama T. Postnatal depression, maternal bonding failure, and negative attitudes towards pregnancy: a longitudinal study of pregnant women in Japan. *Arch Womens Ment Health*. 2012; 15(3):211-216.
9. Beck CT. The effects of postpartum depression on child development: a meta-analysis. *Arch Psychiatr Nurs*. 1998;12:12-20.
10. Porter CL, Hsu HC. First-time mothers' perceptions of efficacy during the transition to motherhood: links to infant temperament. *J Fam Psychol*. 2003;17:54-64.
11. Rahman A, Iqbal Z, Bunn J, et al. Impact of maternal depression on infant nutritional status and illness: a cohort study. *Arch Gen Psychiatry*. 2004;61:946-952.
12. Turcotte-Tremblay AM, Lim R, Laplante DP, et al. Prenatal maternal stress predicts childhood asthma in girls: Project Ice Storm [published online May 8, 2014]. *Biomed Res Int*. 2014;2014:201717. doi: 10.1155/2014/201717
13. Hay DF, Pawlby S, Waters CS, et al. Antepartum and postpartum exposure to maternal depression: different effects on different adolescent outcomes. *J Child Psychol Psychiatry*. 2008;49:1079-1088.
14. Talge NM, Neal C, Glover V. Antenatal maternal stress and long-term effects on child neurodevelopment: how and why? *J Child Psychol Psychiatry*. 2007;48:245-261.
15. 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.
16. Okano T, Murata M, Msuji F, et al. Validation and reliability of Japanese version of the EPDS [in Japanese]. *Arch Psychiatr Diag Clin Eval*. 1996;7:525-533.
17. Ethical guidelines for clinical studies [in Japanese]. Japanese Ministry of Health, Labour and Welfare website. https://www.mhlw.go.jptopicsbukyokuseisakukojindl161228rinsyou.pdf. Accessed October 10, 2014.
18. WMA Declaration of Helsinki—ethical principles for medical research involving human subjects. http://www.wma.net/en/30publications/10policies/b3/index.html. Accessed October 10, 2014.
19. Yamashita H, Yoshida K, Nakano H, et al. Postnatal depression in Japanese women. Detecting the early onset of postnatal depression by closely monitoring the postpartum mood. *J Affect Disord*. 2000;58: 145-154.
20. Saigai ni kakawaru jyuka no higai nintei kijyun unyou shishin. Cabinet Office, Government of Japan website. http://www.bousai.go.jp/taisaku/pdf/shishin002.pdf. Accessed October 10, 2014.
21. Mercer RT. The nurse and maternal tasks of early postpartum. *MCN Am J Matern Child Nurs*. 1981;6:341-345.
22. Sleutel MR. Intrapartum nursing: integrating Rubin's framework with social support theory. *J Obstet Gynecol Neonatal Nurs*. 2003;32:76-82.
23. Anderson JG, Taylor AG. Effects of healing touch in clinical practice: a systematic review of randomized clinical trials. *J Holist Nurs*. 2011; 29:221-228.
24. Tanaka A, Masaoka Y, Koiwa N, et al. Effects of rub and touch on emotion and respiration in humans. *Showa Univ J Med Sci*. 2013; 25:59-66.
25. Shibahara S. The 2011 Tohoku earthquake and devastating tsunami. *Tohoku J Exp Med*. 2011;223:305-307.
26. Shibahara S. Revisiting the March 11, 2011 earthquake and tsunami: resilience and restoration. *Tohoku J Exp Med*. 2012;226:1-2.
27. Xiong X, Harville EW, Mattison DR, et al. Hurricane Katrina experience and the risk of post-traumatic stress disorder and depression among pregnant women. *Am J Disaster Med*. 2010;5:181-187.
28. Ehrlich M, Harville E, Xiong X, et al. Loss of resources and hurricane experience as predictors of postpartum depression among women in southern Louisiana. *J Womens Health (Larchmt)*. 2010;19:877-884.
29. Qu Z, Tian D, Zhang Q, et al. The impact of the catastrophic earthquake in China's Sichuan province on the mental health of pregnant women. *J Affect Disord*. 2012;136:117-123.
30. Qu Z, Wang X, Tian D, et al. Post-traumatic stress disorder and depression among new mothers at 8 months later of the 2008 Sichuan earthquake in China. *Arch Womens Ment Health*. 2012;15:49-55.
31. Hibino Y, Takaki J, Kambayashi Y, et al. Health impact of disaster-related stress on pregnant women living in the affected area of Noto Peninsula earthquake in Japan. *Psychiatry Clin Neurosci*. 2009;63: 107-115.
32. Hibino Y, Takaki J, Kambayashi Y, et al. Relationship between the Noto-Peninsula earthquake and maternal postnatal depression and child-rearing. *Environ Health Prev Med*. 2009;14:255-260.

https://doi.org/10.1017/dmp.2015.51 Published online by Cambridge University Press