| | |
|---|---|
| Title | Immediate mental consequences of the great east Japan earthquake and Fukushima nuclear power Plant accident on mothers experiencing miscarriage, abortion, and stillbirth: the Fukushima health management survey |
| Author(s) | Yoshida-Komiya, Hiromi; Goto, Aya; Yasumura, Seiji; Fujimori, Keiya; Abe, Masafumi |
| Citation | Fukushima Journal of Medical Science. 61(1): 66-71 |
| Issue Date | 2015 |
| URL | http://ir.fmu.ac.jp/dspace/handle/123456789/464 |
| Rights | © 2015 The Fukushima Society of Medical Science |
| DOI | 10.5387/fms.2014-33 |
| Text Version | publisher |

Fukushima J. Med. Sci.,
Vol. 61, No. 1, 2015

**[Original Article]**

# IMMEDIATE MENTAL CONSEQUENCES OF THE GREAT EAST JAPAN EARTHQUAKE AND FUKUSHIMA NUCLEAR POWER PLANT ACCIDENT ON MOTHERS EXPERIENCING MISCARRIAGE, ABORTION, AND STILLBIRTH : THE FUKUSHIMA HEALTH MANAGEMENT SURVEY

HIROMI YOSHIDA-KOMIYA[1)], AYA GOTO[2)], SEIJI YASUMURA[2,3)], KEIYA FUJIMORI[1,3)], MASAFUMI ABE[3)], FOR THE PREGNANCY AND BIRTH SURVEY GROUP OF THE FUKUSHIMA HEALTH MANAGEMENT SURVEY

[1)]*Department of Obstetrics and Gynecology, Fukushima Medical University, Fukushima, Japan,* [2)]*Department of Public Health, Fukushima Medical University, Fukushima, Japan,* [3)]*Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima, Japan*

(Received December 16, 2014, accepted April 7, 2015)

**Abstract : Background :** The Fukushima Pregnancy and Birth Survey was launched to monitor pregnant mothers' health after the Great East Japan Earthquake and Fukushima Daiichi Nuclear Power Plant (NPP) accident. Several lines of investigations have indicated that a disaster impacts maternal mental health with childbirth. However, there is no research regarding mental health of mothers with fetal loss after a disaster. In this report, we focus on those women immediately after the Great East Japan Earthquake and Fukushima NPP accident and discuss their support needs.
**Materials and Methods :** Data regarding 61 miscarriages, 5 abortions, and 22 stillbirths were analyzed among the women who were pregnant at the time of the accident in the present study. We used a two-item case-finding instrument for depression screening, and compared the childbirth group with the fetal loss groups. We also analyzed mothers' opinions written as free-form text.
**Results :** Among the three fetal loss groups, the proportion of positive depression screens was significantly higher in the miscarriage and stillbirth group than in the childbirth group. Mothers' opinions were grouped into six categories, with pregnancy-related items being most common, especially in the miscarriage and stillbirth groups.
**Conclusion :** A higher proportion of Fukushima mothers with fetal loss, especially those with miscarriage and stillbirth, had depressive symptoms compared to those who experienced childbirth. Health care providers need to pay close attention to this vulnerable group and respond to their concerns regarding the effects on their fertility.

**Key words :** Depression, Great East Japan Earthquake, Fukushima Nuclear Accident, Pregnancy, Spontaneous Abortion, Stillbirth

## INTRODUCTION

The mental health of women with fetal loss such as miscarriage, abortion, and stillbirth has not attracted healthcare providers' attention until recently. Sudden, expected, or unexpected pregnancy loss can cause mothers and their families to suffer with profound grief and mental health issues such as depression and anxiety. In recent years, many researchers have reported that fetal loss is related to mental health issues such as depression, anxiety, and post-traumatic stress[1,2)]. Recently, Bellieni and Buonocore[1)] reviewed research literature on the psychological and psychiatric issues of mothers with

Corresponding author : Hiromi Yoshida-Komiya E-mail : hiromiy@fmu.ac.jp
https://www.jstage.jst.go.jp/browse/fms http://www.fmu.ac.jp/home/lib/F-igaku/

pregnancies that ended in abortion and miscarriage. They concluded that fetal loss appears to predispose women to a higher risk for mental disorders than childbirth, and that abortion can be considered to involve risks comparable to that of miscarriage, although further investigation is needed. In cases of stillbirth, the death of a baby occurs at or near full-term and the etiology is not elucidated in many cases. Therefore, bereaved mothers often suffer from feelings of guilt and shame, which last over a long period[2,3].

On March 11 2011, immediately after the Great East Japan Earthquake, a huge tsunami hit the Fukushima Daiichi Nuclear Power Plant (NPP) and caused serious damage. As a result, large amounts of radioactive materials were released into the environment. Frequencies of abortions and miscarriages were reported not to have increased[4]. However, negative mental health consequences of mothers were reported after the Chernobyl accident[5], and other disasters such as terrorist attacks, environmental disasters, earthquakes, hurricanes, and other natural disasters[6]. These investigations demonstrated that pregnant and postpartum women are vulnerable to the effects of disaster on mental health, however, as of yet there is no research on the effects of disaster on women experiencing fetal loss. Therefore, the influence of the Great East Japan Earthquake and Fukushima NPP accident on the mental health of women with negative pregnancy consequences is of particular concern. In the present survey, we focused on evaluating the mental health status of mothers who experienced miscarriage, abortion, and stillbirth immediately after this earthquake and NPP accident.

## MATERIALS AND METHODS

The Pregnancy and Birth Survey was included in the Fukushima Health Management Survey as described in a previous report[7,8]. Briefly, the subjects of this investigation were women receiving a maternity health record book from Fukushima prefecture from August 1 2010 to July 31 2011. Questionnaires were distributed to 16,001 women and 9,321 responded. Mothers with fetal loss were divided into three groups based on the type of loss : miscarriage, abortion, and stillbirth. Data from 88 mothers with fetal loss (61 miscarriages, 5 abortions, and 22 stillbirths) were analyzed. In mothers with childbirth, characteristics of 8,196 women experiencing live births of singletons were summarized. Excluded were 458 women whose pregnancies ended before the accident, 146 women with unknown dates of pregnancy outcome, 9 women who were pregnant twice during the targeted period, 9 women who delayed responding, 22 women who left Fukushima Prefecture, 232 women who had other than a live birth as a pregnancy outcome, 85 women with twin pregnancies, 62 women who did not fill out the questionnaires by themselves, and 198 women who missed responding to the depression measure, with overlaps among these exclusion criteria as described in previous research[9].

Mental health was evaluated using a two-item case-finding instrument for depression. This is reported to be a useful and quick method for detecting depression in primary care, and validity of this measurement was similar to six previously validated instruments[10]. This questionnaire includes two questions about depressed mood and anhedonia as follows : "During the past month, have you often been bothered by feeling down, depressed, or hopeless?" and "During the past month, have you often been bothered by having little interest or pleasure in doing things?" Mothers who answered yes to one of these questions were classified as positive for depressive symptoms.

The contents of women's opinions written in free-form text were categorized into six groups : child-related, pregnancy- related, service- related, mother's health- related, radiation measurement-related, and other. These were categorized, double-checked, and entered into the survey database with the other quantitative data. In order to study the content of the pregnancy-related items in detail, two researchers (KH and GA) read and summarized the original texts written by respondents independently, and then, compared and combined the results.

Of note, the Fukushima Health Management Survey provided telephone counseling by trained midwives or public health nurses to those who were screened positive for depression or wrote concerns in the free-space provided in the questionnaire.

We compared the characteristics regarding pregnancy history, psychiatric history before pregnancy and mode of pregnancy, and frequency of depressive symptoms, of the miscarriage, abortion, and stillbirth groups with a live birth group using chi-square or Fisher's exact test. Open Epi Version 3.01 was used for the statistical analyses. The level of statistical significance was set at $p < 0.05$.

This study was approved by the Ethics Committee of Fukushima Medical University. It was conducted in accordance with the guidelines ex-

pressed in the Declaration of Helsinki. Responders' anonymity has been preserved to protect the privacy and confidentiality of their personal information.

## RESULTS

Characteristics of mothers experiencing fetal loss and childbirth are shown in Table 1. In terms of history of previous pregnancies, women with current miscarriages in the survey had significantly higher proportions of previous miscarriage and stillbirth than those in the childbirth group. In addition, women with previous stillbirth had experienced more previous stillbirths as compared to the childbirth group. None of the women in the three fetal loss groups had experienced psychiatric disease prior to the survey, and 2% of women in the childbirth group had a history of psychiatric disease.

In the analysis of depression status using the two-item case-finding instrument for depression, the percentage answering "yes" to the first or second question was 41%, 60%, 55%, and 28% for the miscarriage, abortion, stillbirth, and childbirth groups (Table 2). The proportion of those screening positive for depression was significantly higher in the miscarriage and stillbirth group than in the childbirth group. The odds ratios of depressive symptoms in women with miscarriage and stillbirth to those with childbirth were 1.82 (95% CI 1.09-3.04) and 3.14 (95% CI 1.36-7.30), respectively.

As shown in Table 3, the frequency of pregnancy-related items reported in the free-form text (9 and 7 respectively) were higher than that of the other items for the miscarriage and stillbirth groups.

Original texts of women's opinions written in a free space on the questionnaire indicated concern on the part of women experiencing fetal loss. Women in both the miscarriage and stillbirth groups questioned the influence of the nuclear accident on their negative pregnancy outcomes and were concerned about future pregnancies. Moreover, mothers who experienced stillbirth criticized the lack of accurate information and support immediately after the disaster.

Table 1. Characteristics of respondents experiencing miscarriage, abortion, stillbirth, and childbirth

| Characteristics | Miscarriage ($N$ = 61) | Abortion ($N$ = 5) | Stillbirth ($N$ = 22) | Childbirth ($N$ = 8196) |
|---|---|---|---|---|
| Mother's age at the time of pregnancy (years ± S.D.) | 30.1 ± 5.0 | 29.2 ± 9.1 | 30.0 ± 5.0 | 30.1 ± 5.0 |
| Pregnancy history $n$ (%) | | | | |
| Birth | | | | |
| Not reported | 14 (23) | 3 (60) | 6 (27) | 2,634 (32) |
| ≥1 | 47 (77) | 2 (40) | 16 (73) | 5,562 (68) |
| Miscarriage | | | | |
| Not reported | 36 (59)** | 3 (60) | 20 (91) | 6,721 (82) |
| ≥1 | 25 (41) | 2 (40) | 2 (9) | 1,475 (18) |
| Abortion | | | | |
| Not reported | 50 (82) | 3 (60) | 19 (86) | 7,164 (87) |
| ≥1 | 11 (18) | 2 (40) | 3 (14) | 1,032 (13) |
| Stillbirth | | | | |
| Not reported | 57 (93)** | 4 (80) | 13 (59)** | 8,110 (99) |
| ≥1 | 4 (7) | 1 (20) | 9 (41) | 86 (1) |
| Psychiatric history before pregnancy $n$ (%) | | | | |
| No | 61 (100) | 5 (100) | 22 (100) | 8,071 (98) |
| Yes | 0 (0) | 0 (0) | 0 (0) | 125 (2) |
| Mode of pregnancy $n$ (%) | | | | |
| Natural or no answer | 59 (97) | 5 (100) | 20 (91) | 7,863 (96) |
| Induced ovulation, IUI, IVF | 2 (3) | 0 (0) | 2 (9) | 333 (4) |

IUI : Intrauterine insemination, IVF : In vitro fertilization.
Chi-square or Fisher's exact tests for 2 × 2 contingency tables were conducted by combining "no" and "no answer."
*$p < 0.01$, **$p < 0.05$ as compared with childbirth.

Table 2. Depression status of mothers experiencing miscarriage, abortion, stillbirth, and childbirth based on a two-question case-finding instrument for depression

| Questions | Miscarriage ($N$ = 61) | Abortion ($N$ = 5) | Stillbirth ($N$ = 22) | Childbirth ($N$ = 8196) |
|---|---|---|---|---|
| Number of symptoms | | | | |
| 0 | 36 (59)* | 2 (40) | 10 (45)* | 5,934 (72) |
| >1 | 25 (41) | 3 (60) | 12 (55) | 2,262 (28) |
| Depressed mood | | | | |
| No & no answer | 39 (64)** | 2 (40)** | 12 (55)** | 6,111 (75) |
| Yes | 22 (36) | 3 (60) | 10 (45) | 2,085 (25) |
| Anhedonia | | | | |
| No & no answer | 45 (74) * | 2 (40) * | 15 (68)** | 6,944 (85) |
| Yes | 16 (26) | 3 (60) | 7 (32) | 1,252 (15) |

Chi-square or Fisher's exact tests for 2 × 2 contingency table was conducted by combining "no" and "no answer."
*$p < 0.01$, **$p < 0.05$ as compared with childbirth.

Table 3. Number of types of mother's opinions in six categories for the miscarriage, abortion, and stillbirth groups

| Characteristics | Miscarriage ($N$ = 61) | Abortion ($N$ = 5) | Stillbirth ($N$ = 22) |
|---|---|---|---|
| No. and percentage of respondent with free-form text | 15 (25) | 3 (60) | 13 (59) |
| Type of mother's opinion | | | |
| Pregnancy-related | 9 | 0 | 7 |
| Service- related | 3 | 1 | 2 |
| Radiation measurement-related | 0 | 1 | 3 |
| Child-related | 3 | 0 | 0 |
| Mother's health-related | 0 | 1 | 0 |
| Other | 0 | 0 | 1 |

Pregnancy-related items : Outcome of this pregnancy, influence on next pregnancy
Service-related items : Poor amount of information, insufficiency of medical service, shortage of daily necessities, difficulty in living, support for cost of goods, support for cost of living
Radiation measurement-related items : Supply of dosimeter, health examination, internal and/or external exposure, urine analysis, analysis of breast milk, ultrasonography survey of thyroid cancer
Child-related items : Water, breast or powdered milk, food, going or playing outside, influence on children
Mother's health-related items : Psychiatric disorders of the mother in question
Other : Information transmission, decontamination from the radioactive material, complete medical service, support of refuge, complete child care service, mental care and consulting service, complaints about this survey, approval of this survey

## DISCUSSION

The results of this study demonstrated that the percentage of mothers in a depressive state was higher for those experiencing fetal loss (especially miscarriage and stillbirth) versus childbirth, after the Great East Japan Earthquake and Fukushima NPP accident. When asked for their opinions in a free-text form, most women experiencing miscarriage and stillbirth provided text that was categorized as pregnancy-related. It appeared that mothers experiencing miscarriage and stillbirth felt disappointed about the accident, which might have been related to the fetal loss, and anxious about future pregnancy outcomes. This paper is the first to report on the depressive symptoms of bereaved mothers experiencing fetal loss after the disaster and NPP explosion.

Recent investigations have suggested that miscarriage, abortion, and stillbirth are associated with psychological well-being. Toffol *et al.* reported that a miscarriage affected women's mental health in a negative way ; those with a higher number of miscarriages were worse in the current state of mood

and with a higher frequency of psychiatric diseases than those with less frequent miscarriages.[11] As for abortion, it was demonstrated that women having abortions were at clear risk for mental health issues as compared with those who gave birth. Stillbirth is also reported to be a significant risk factor for maternal psychological disorders such as depression, anxiety, and post-traumatic stress disorder (PTSD), especially in the case when conception occurs soon after the fetal loss[12,13]. A seven-year long-term follow-up revealed that mothers experiencing stillbirth continued to have PTSD[14]. Our presented results were in line with these previous reports ; we observed a statistically higher proportion of women screened positive for depression in the miscarriage and stillbirth groups, with a similar tendency in the abortion group, compared with the childbirth group.

Many studies on the effects of various disasters (including natural and human-made disasters) on maternal mental health have indicated that pregnant and postpartum women may be especially vulnerable[6]. Examples include a study after the World Trade Center disaster, which reported that pregnant women attacked directly were more likely to be depressive[15]. After the 2005 Pakistan earthquake, reproductive health events significantly varied depending on the levels of economic deprivation, family support, access to health care facilities, and clinical severity of depression and anxiety[16]. In the 2007 Noto earthquake in Japan, however, overall depression scores were not high in a hospital-based sample of 99 pregnant women[17]. Another nuclear reactor accident at Chernobyl, Ukraine in 1986 is well known as an environmental disaster, which involved a much larger radiation leak and affected more people and environment than Fukushima. It has been reported that the Chernobyl NPP accident predisposed adults to psychological issues ; in particular, depression, PTSD, and acute distress persisted in evacuee mothers even 11 to 19 years after the event[18,19]. These studies suggest that disasters impact maternal mental health ; however, the impact may vary depending on the type, severity and location of a disaster, as well as the socio-economic situation of the countries.

To date, the mental health of mothers who experienced fetal loss after the Great East Japan Earthquake and Fukushima NPP accident has not yet been investigated. This study suggested that the mental health of mothers experiencing fetal loss, especially miscarriage and stillbirth, was clearly impaired after the Great East Japan Earthquake and Fukushima NPP accident. Even at the time of disaster, it is recommended that healthcare providers such as clinicians, midwives, public health nurses, and clinical psychotherapists keep in mind an importance of providing grief care, so that mothers, fathers, and family members do not suffer alone with the fetal loss in a severe condition[3,20]. The Inter-Agency Standing Committee guidelines recommend strengthening existing resources and capacities as one of the core principles in mental health support in a disaster setting[21]. North and Pfefferbaum also described that the case identification, triaged care, and delivery of appropriate mental health interventions should be integrated into emergency medicine and trauma care responses[22]. In addition to standard care needed for this vulnerable group of women, healthcare professionals should improve their communication skills regarding the effects of radiation on pregnancy, which mothers were particularly worried about. It would be important to communicate local data, such as that the Pregnancy and Birth Survey of the Fukushima Health Management reported no significant radiation impact on pregnancy outcomes after the Great East Japan Earthquake and Fukushima NPP accident[8].

This report has the following limitations. (1) Since the number of mothers experiencing fetal loss was small compared to those experiencing childbirth, it was not possible to carry out a detailed statistical analysis to investigate further the differences between these groups. (2) Since this study was conducted immediately after the Great East Japan Earthquake and Fukushima NPP accident, the long-term mental health of mothers experiencing miscarriage, abortion, and stillbirth was not explored. (3) Our main outcome measure was conventional depression screening with a two-question case-finding instrument for primary care evaluation. Therefore, it is possible that the true prevalence of depression is lower than that reported here.

In conclusion, all should offer effective emotional support and care for the needs of mothers with negative pregnancy outcomes to assist them in their recovery under a disaster setting.

**ACKNOWLEDGMENTS**

This survey was supported by the national "Health Fund for Children and Adults Affected by the Nuclear Incident." The findings and conclusions of this article are solely the responsibility of the authors and do not represent the official views of Fukushima prefecture government. The authors do not have any conflicts of interest to declare.

## REFERENCES


1. Bellieni CV, Buonocore G. Abortion and subsequent mental health : Review of the literature. Psychiatry Clin. Neurosci, **67** : 301-310, 2013.
2. Froen JF, Cacciatore J, McClure EM, *et al*. Stillbirths : Why they matter. Lancet, **377** : 1353-1366, 2011.
3. Cacciatore J. Psychological effects of stillbirth. Semin. Fetal Neonatal Med, **18** : 76-82, 2013.
4. Fujimori K, Nomura Y, Hata K. Pregnant and and birth survey after the Great East Japan earthquake and Fukushima Daiichi nuclear power plant accident in Fukushima prefecture. Fukushima J Med Sci, **60** : 106-107, 2014.
5. Bromet EJ, Havenaar JM, Guey LT. A 25 year retrospective review of the psychological consequences of the Chernobyl accident. Clin Oncol, **23** : 297-305, 2011.
6. Harville EW, Xiong X, Buekkens P. Disasters and perinatal health : A systematic review. Obstet Gynnecol Surv, **65** : 713-728, 2010.
7. Yasumura S, Hosoya M, Yamashita S, *et al*. Study protocol for the Fukushima Health Management Survey. J Epidemiol, **22** : 375-383, 2012.
8. Fujimori K, Kyozuka H, Yasuda S, *et al.* Pregnancy and birth survey after the Great East Japan earthquake and Fukushima Daiichi nuclear power plant accident in Fukushima prefecture. Fukushima J Med Sci, **60** : 75-81, 2014.
9. Goto A, Bromet E, Fujimori K, *et al*. Immediate effects of the Fukushima nuclear power plant disaster on depressive symptoms among mothers with infants : a prefectural-wide cross-sectional study from the Fukushima Health Management Survey. BMC Psychiatry, **15** : 59, 2015.
10. Whooley MA, Avins AL, Miranda J, Browner WS. Case-finding instruments for depression Two questions are as good as many. J Gen Intern Med, **12** : 439-445, 1997.
11. Toffol E, Koponen P, Partonen T. Miscarriage and mental health : results of two population-based studies. Psychiatry Res, **205** : 151-158, 2013.
12. Hughes PM, Turton P, Evans C. Stillbirth as risk factor for depression and anxiety in the subsequent pregnancy : Cohort study. BMJ, **318** : 1721-1724, 1999.
13. Turton P, Hughes P, Evans C, Fainman D. Incidence, correlates and predictors of post-traumatic stress disorder in the pregnancy after stillbirth. Br J Psychiatry, **178** : 556-560, 2001.
14. Turton P, Evans C, Hughes P. Long-term psychosocial sequelae of stillbirth : Phase II of a nested case-control cohort study. Arch Womens Ment Health, **12** : 35-41, 2009.
15. Lewis MW, Lanzara BL, Stein JL, *et al*. Maternal drinking patterns and drug use increase impact of terrorism among pregnant women attending perinatal care. J Prenatal & Perinatal Psychology &Health, **19** : 275-288, 2005.
16. Anwar J, Mpofu E, Matthews LR, Shadoul AF, Brock KE. Reproductive health and access to healthcare facilities : risk factors for depression and anxiety in women with an earthquake experience. BMC Public Health, **11** : 523-536, 2011.
17. Hibino Y, Takaki J, Kambayashi Y, *et al*. Health impact of disaster-related stress on pregnant women living in the affected area of the Noto Peninsula earthquake. Psychiatry Clin Neurosci, **63** : 107-115, 2009.
18. Adams RE, Bromet EJ, Panina N, Golovakha E. Stress and well-being in mothers of young children 11 years after the Chernobyl nuclear power plant accident. Psychol Med, **32** : 143-156, 2002.
19. Adams RE, Guey LT, Gluzman SF, Bromet EJ. Psychological well-being and risk perceptions of mothers in Kyiv, Ukraine, 19 years after the Chernobyl disaster. Int J Soc Psychiatry, **57** : 637-645, 2011.
20. Leyland A. The midwife's role in caring for the needs of bereaved parents following a stillbirth. Pract Midwife, **16** : 20-22, 2013.
21. Inter-Agency Standing Committee : ISAC Guidelines on mental health and psychosocial support in emergency settings. [Cited 14 February 2014.] Available from [http://www.who.int/mental_health/emergencies/guidelines_iasc_mental_health_psychosocial_june_2007.pdf]
22. North CS, Pfefferbaum MD. Mental health response to community disasters. A systematic review. JAMA, **310** : 507-518, 2013.