Impact of intention and feeling toward being pregnant on postpartum depression: the Japan Environment and Children’s Study (JECS)

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Abstract
Pregnancy intention is reported to be associated with the risk of postpartum depression (PPD), but the impact of feelings toward being pregnant on PPD is unknown. We aimed to examine whether feelings toward being pregnant are associated with PPD at 1 month after childbirth. In our nationwide study between 2011 and 2014 in Japan, we used multivariate logistic regression analyses to examine the associations between pregnancy intention and feelings toward being pregnant with PPD [Edinburgh Postnatal Depression Scale (EPDS score > 9 or > 12)] among Japanese women. Among 92,431 women, 14.0 and 5.4% had PPD with EPDS scores > 9 and > 12, respectively. Compared with women who felt very happy to be pregnant, those whose pregnancy was unintended but happy, unintended and confused, those who felt troubled, and those who felt no emotion toward being pregnant had increased risks of PPD [multivariable odds ratios (95% confidence intervals (CIs)) = 1.17 (1.11–1.22), 1.39 (1.29–1.49), 1.74 (1.42–2.14), and 1.58 (1.22–2.02), respectively, for EPDS score > 9]. Those associations were more evident without antenatal possible mental illness (K6 score < 13). Women whose pregnancy was unintended should be regarded as targets for the early detection and prevention of PPD irrespective of whether they felt happy or confused.

Keywords Unplanned pregnancy · Unwanted pregnancy · Emotion · Happiness · Postpartum depression

Introduction
Postpartum depression (PPD) is a major concern in reproductive health (O’Hara and McCabe 2013). The prevalence of PPD differs by the diagnosis criteria and timing (O’Hara and Swain 1996) but is reported to be between 9 and 24% among Japanese women (Ministry of Health, Labour, and Welfare 2013; Norhayati et al. 2015) and between 10 and 15% among US women (Patel et al. 2012). Recently, the time period of diagnosis was stated in the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5), and PPD is defined as depressive episodes that occur during pregnancy and within 4 weeks of childbirth (American Psychiatric Association 2013). Thus, monitoring and evaluating the prevalence and risk factors for PPD according to the defined period are essential. PPD is associated with adverse health outcomes for infants (Stein et al. 1991; Kingston et al. 2012) as well as for mothers (van Wijngaarden et al. 2004).
Materials and methods

Study population

The JECS is a nationwide government-funded birth cohort study that began recruiting expectant mothers in January 2011. Fifteen Regional Centers (Hokkaido, Miyagi, Fukushima, Chiba, Kanagawa, Koshin, Toyama, Aichi, Kyoto, Osaka, Hyogo, Tottori, Kochi, Fukuoka, and South Kyushu/Okinawa) were selected. Women were recruited during early pregnancy at obstetrics clinics/hospitals and/or local municipal offices issuing mother and child health handbooks. Recruitment started in January 2011 and continued until March 2014. The JECS protocol has been published elsewhere (Kawamoto et al. 2014; Michikawa et al. 2018). The details of the JECS have been described in previous studies (Michikawa et al. 2015; Suzuki et al. 2016). The study included data measured at enrollment during the first trimester, at pregnancy checkup examination during the second trimester, at delivery, and at postpartum 1 month by pregnant women and obstetricians.

Participants

Among 103,099 pregnancies, we only included those with a live singleton infant (n = 98,259). The complete information on pregnancy intention and their feelings toward being pregnant, and PPD status was available for 92,431 pregnancies out of the 98,259 recruited pregnancies (94.1%).

Ethical issues

The JECS protocol was reviewed and approved by the Ministry of the Environment’s Institutional Review Board on Epidemiological Studies and by the Ethics Committees of all participating institutions. The JECS was conducted in accordance with the Declaration of Helsinki and other nationally valid regulations and guidelines.

Variables

Data on women’s feelings toward being pregnant, including pregnancy intention, were collected at the time of the registration generally during the first trimester. Data were primarily combined and categorized into five groups according to the women’s answers to the question “When you recognized the current pregnancy, how did you feel?” (1) Very happy, (2) unintended but happy, (3) unintended and confused, (4) troubled, and (5) no emotion.

We collected a Japanese-language Edinburgh Postnatal Depression Scale (EPDS) score at 1 month after childbirth. EPDS (Cox et al. 1987), which comprises 10 items listed in a four-point Likert scale from 0 to 3 according to the
increasing severity of symptoms, ranges from “Yes, most of the time,” “Yes, sometimes,” “Not very often,” to “No, not at all.” Okano et al. translated the EPDS into Japanese, back-translated the scale, conducted the test–retest method to examine reliability, and calculated Cronbach’s α (0.78) (Okano et al. 1996). Okano et al. reported that the appropriate cutoff point for detecting PPD was 9 or higher, with 75% sensitivity and 93% specificity (Yamaoka et al. 2016; Muchanga et al. 2017), whereas 12 or higher is generally used as the cutoff point worldwide (Cox et al. 1987). A recent study on Japanese women has shown the optimal cutoff of EPDS score for major depressive episode during pregnancy as 12 (Usuda et al. 2017). We, therefore, used both cutoff points ≥9, and ≥12, in this study.

The covariates included women’s age, parity, marital status, smoking habit, education, annual family equivalent income, intimate partner verbal violence at pregnancy (IPV), possible mental illness during a month prior to enrollment, and history of antidepressant use.

| Table 1 Characteristics of participants | Number of women | Postpartum depression (EPDS ≥ 9) | Postpartum depression (EPDS ≥ 12) |
|-----------------------------------------|----------------|----------------------------------|----------------------------------|
|                                         | n              | Proportion (%)                   | n                               | Proportion (%)                   |
| Total                                   | 92,431         | 12,943                           | 14.0                             | 4951                            | 5.4 |
| Pregnancy intention and feeling of being pregnant |                |                                  |                                  |                                 |
| Very happy                              | 61,045         | 7369                             | 12.1                             | 2584                            | 4.2 |
| Unintended but happy                    | 23,997         | 3879                             | 16.2                             | 1598                            | 6.7 |
| Unintended and confused                 | 6425           | 1411                             | 22.0                             | 613                             | 9.5 |
| Troubled                                | 535            | 186                              | 34.8                             | 112                             | 20.9 |
| No emotion                              | 429            | 98                               | 22.8                             | 44                              | 10.3 |
| Age, year                               |                |                                  |                                  |                                 |
| < 20                                    | 737            | 181                              | 24.6                             | 84                              | 11.4 |
| 20–29                                   | 33,772         | 5507                             | 16.3                             | 2205                            | 6.5 |
| 30–39                                   | 53,737         | 6720                             | 12.5                             | 2442                            | 4.5 |
| 40+                                     | 4185           | 535                              | 12.8                             | 220                             | 5.3 |
| Parity                                  |                |                                  |                                  |                                 |
| Primiparous                             | 36,259         | 6505                             | 17.9                             | 2502                            | 6.9 |
| Multiparous                             | 54,048         | 6054                             | 11.2                             | 2308                            | 4.3 |
| Missing                                 | 2124           | 384                              | 18.1                             | 141                             | 6.6 |
| Marital status                          |                |                                  |                                  |                                 |
| Married                                 | 88,186         | 11,900                           | 13.5                             | 4463                            | 5.1 |
| Never (not yet)                         | 3126           | 738                              | 23.6                             | 321                             | 10.3 |
| Divorced                                | 734            | 206                              | 28.1                             | 114                             | 15.5 |
| Widowed                                 | 15             | 4                                | 26.7                             | 2                              | 13.3 |
| Missing                                 | 370            | 39                              | 25.7                             | 51                              | 13.8 |
| Smoking                                 |                |                                  |                                  |                                 |
| Never                                   | 53,721         | 6,623                            | 12.3                             | 2428                            | 4.5 |
| Former                                  | 21,795         | 3,021                            | 13.9                             | 1107                            | 5.1 |
| Quit smoking                            | 12,028         | 2248                             | 18.7                             | 939                             | 7.8 |
| Continued smoking                       | 4254           | 934                              | 22.0                             | 429                             | 10.1 |
| Missing                                 | 633            | 117                              | 18.5                             | 48                              | 7.6 |
| Education                               |                |                                  |                                  |                                 |
| Junior high school                      | 4233           | 940                              | 22.2                             | 457                             | 10.8 |
| High school                             | 28,682         | 4681                             | 16.3                             | 1929                            | 6.7 |
| Vocational school                       | 22,509         | 2961                             | 13.2                             | 1060                            | 4.7 |
| Junior college                          | 16,155         | 1961                             | 12.1                             | 668                             | 4.1 |
| University and higher                   | 19,907         | 2243                             | 11.3                             | 757                             | 3.8 |
| Missing                                 | 945            | 157                              | 16.6                             | 80                              | 8.5 |
| Family income (equivalent income)       |                |                                  |                                  |                                 |
| Q1 (lowest)                             | 24,921         | 3895                             | 15.6                             | 1616                            | 6.5 |
| Q2                                      | 13,069         | 2279                             | 17.4                             | 890                             | 6.8 |
| Q3                                      | 28,508         | 3513                             | 12.3                             | 1236                            | 4.3 |
| Q4 (highest)                            | 18,855         | 2034                             | 10.8                             | 686                             | 3.6 |
| Missing                                 | 7078           | 1222                             | 17.3                             | 523                             | 7.4 |
| Intimate partner violence               |                |                                  |                                  |                                 |
| None                                    | 80,857         | 9934                             | 12.3                             | 3563                            | 4.4 |
| Rarely                                  | 7461           | 1761                             | 23.6                             | 776                             | 10.4 |
| Sometimes                               | 3128           | 906                              | 29.0                             | 430                             | 13.7 |
| Often                                   | 689            | 274                              | 39.8                             | 143                             | 20.8 |
| Missing                                 | 296            | 68                               | 23.0                             | 39                              | 13.2 |
| Antenatal possible mental illness (K6 score) |            |                                  |                                  |                                 |
| No (K6 < 13)                            | 89,306         | 11,211                           | 12.6                             | 3905                            | 4.4 |
| Yes (K6 ≥ 13)                           | 3125           | 1732                             | 55.4                             | 1046                            | 33.5 |
| History of antidepressant use           |                |                                  |                                  |                                 |
| No                                      | 87,755         | 11,291                           | 12.9                             | 4072                            | 4.6 |
| Yes                                     | 4676           | 1652                             | 35.3                             | 879                             | 18.8 |
history of antidepressant use for the past 1 year, and residential area. Marital status, smoking habit, IPV, and antenatal possible mental illness were obtained using the medical records at the registration; education and income during the second trimester; parity at delivery from the obstetrician, and age were obtained from the obstetrician’s record 1 month after childbirth. The information in the medical records was transcribed by physicians, midwives/nurses, or research coordinators. Women’s age was categorized as 5-year age groups; parity as primiparous or multiparous; marital status as married, never (not yet), divorced, and widowed; smoking as never smokers, former smokers who previously smoked but quit before pregnancy, quit smokers who stopped smoking during pregnancy, and continued smokers who continued to smoke during pregnancy; education as junior high school, high school, vocational school, junior college, and university and higher; and IPV as none, rarely, sometimes, and often. Equivalent income was calculated by dividing the average amount in 6-scale family income categories by the square root of the number of family members and re-categorized into quartiles.

Women’s possible mental illness during the past month prior to enrollment was assessed using a Japanese version of the Kessler 6 (K6) scale. The K6 score is originally used for screening “serious mental illness” (Kessler et al. 2003) or mood and anxiety disorders (Furukawa et al. 2003) in the general population, with a cutoff point of 13 or higher (Kessler et al. 2003; Furukawa et al. 2003). A Japanese version of K6 was developed and validated with a similar cutoff point (12/13) (Furukawa et al. 2008). Therefore, we regarded K6 score ≥ 13 as possible mental illness. The history of antidepressant use was determined by a question regarding the use of antidepressants in the past year. Residential areas were represented by the locations of the 15 Regional Centers where the data were collected.

**Statistical analyses**

Multivariable logistic regression analyses were used to estimate the association between feelings toward being pregnant and the risk of PPD. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated after adjusting for potential confounders. Using the category of women with a “very happy” feeling as the reference group, we estimated the risk of PPD (EPDS score ≥ 9 and ≥ 12) among women whose pregnancy was unintended but happy, unintended and confused, felt troubled, and those who had no emotion toward being pregnant. We also used multivariable logistic regression analyses stratified by women’s antenatal possible mental illness to examine whether the antenatal possible mental illness modifies the association between the feelings toward being pregnant and PPD (EPDS score ≥ 9 and ≥ 12). All analyses were performed using Statistical Analysis Software version 9.4 (SAS Institute, Inc., Cary, NC, USA).

**Results**

Table 1 shows the characteristics of 92,431 women. Among them, 14.0 and 5.4% had PPD with EPDS scores ≥ 9 and ≥ 12, respectively. Women who regarded their pregnancy as unintended and confused, felt troubled, and those who felt no emotion toward being pregnant had higher proportions of PPD than those who regarded their pregnancy as very happy. High proportions of PPD were also seen in younger, in primiparous, in never married, divorced, or widowed women, in women who quit or continued smoking when pregnant, in women with lower education, in women who experienced IPV, in women with a mental illness (K6 score ≥ 13), and in women with a history of antidepressant use.

Compared with women who felt very happy to be pregnant, women who felt their pregnancy was unintended but happy, unintended and confused, or those who felt no emotion toward being pregnant had an increased risk of PPD: OR (95% CI) = 1.25 (1.20–1.31), 1.64 (1.53–1.76), and 1.67 (1.30–2.13), respectively, for EPDS score ≥ 9, and OR (95% CI) = 1.36 (1.27–1.46), 1.67 (1.51–1.85), and 1.78 (1.26–2.50), respectively, for EPDS score ≥ 12 (Table 2). Women who felt their pregnancy was troubled had the largest risk of PPD compared with those with other feelings: OR (95% CI) = 2.25 (1.83–2.75) for EPDS score ≥ 9 and 2.85 (2.23–3.64) for EPDS score ≥ 12.

Table 2 Multivariable odds ratios (ORs) of postpartum depression (PPD) according to feeling toward being pregnant

| Feeling toward being pregnant | PPD (EPDS score > 9) | PPD (EPDS score > 12) |
|------------------------------|----------------------|-----------------------|
|                              | Multivariable OR (95% CI) | Multivariable OR (95% CI) |
| Very happy                   | Ref                                | Ref                                |
| Unintended but happy         | 1.25 (1.20–1.31)                        | 1.36 (1.27–1.46)                        |
| Unintended and confused      | 1.64 (1.53–1.76)                        | 1.67 (1.51–1.85)                        |
| Troubled                     | 2.25 (1.83–2.75)                        | 2.85 (2.23–3.64)                        |
| No emotion                   | 1.67 (1.30–2.13)                        | 1.78 (1.26–2.50)                        |

* Adjusted for mother’s age, parity, marital status, smoking, mother’s education, household income, intimate partner violence, antenatal possible mental illness (K6), history of antidepressant use, and residential area.
The associations between feelings toward being pregnant and the risk of PPD stratified by antenatal possible mental illness are shown in Table 3. Those associations were generally stronger among women without possible mental illness (K6 score < 13). In those with possible mental illness (K6 score > 13), increased risks for PPD were observed only among women who felt their pregnancy as unintended and confused.

### Discussion and conclusions

In this nationwide study, we found that women who felt their pregnancy was unintended but happy, those who felt their pregnancy was unintended and confused, and those who felt no emotion toward being pregnant had increased risks of PPD (K6 score < 13). In those with possible mental illness (K6 score ≥ 13), increased risks for PPD were observed only among women who felt their pregnancy as unintended and confused.

In the present study, we unexpectedly found an increased risk of PPD among women who felt their pregnancy was unintended but happy. There was a previous report in African-American and Latin populations stating that pregnancy intentions and happiness were strongly associated, but happiness was a better predictor of reduced PPD rather than intention (Blake et al. 2007). Our finding did not meet this notion possibly due to differences in ethnicity, culture, and participants’ characteristics.

In the analysis stratified by antenatal possible mental illness, the associations were weaker among women with possible mental illness, which implies that antenatal possible mental illness modified the association between their feelings toward being pregnant and risk of PPD.

The biological mechanism underlying PPD remains unclear (Patel et al. 2012). Changes in the levels of several hormones after delivery have been suggested to induce PPD, but the findings were inconsistent (Soares and Zitek 2008; Patel et al. 2012; O’Hara and McCabe 2013). In contrast, regarding psychological mechanisms, the feeling toward being pregnant plays a role in PPD; in addition to history of depression and antenatal possible mental illness, antenatal anxiety, perinatal stress, feeling pessimistic during the antenatal period, and fear of childbirth have been considered to be predictors of PPD (O’Hara et al. 1991; Kitamura et al. 2006; Beck 2001, Condon and Watson 1987; Räisänen et al. 2013). Regarding the mechanism by

### Table 3 Adjusted odds ratios of postpartum depression (PPD) according to feeling toward being pregnant, stratified by antenatal possible mental illness (K6 score)

|                        | PPD (EPDS score ≥ 9) | PPD (EPDS score ≥ 12) |
|------------------------|-----------------------|------------------------|
|                        | No. at risk | No. of PPD | Multivariable OR (95% CI) | No. of PPD | Multivariable OR (95% CI) |
| No antenatal possible mental illness (K6 score < 13) (n = 89,306) | | | | |
| Very happy | 59,564 | 6608 | Ref | 2153 | Ref |
| Unintended but happy | 23,017 | 3321 | 1.26 (1.20–1.32) | 1257 | 1.38 (1.28–1.49) |
| Unintended and confused | 5905 | 1081 | 1.65 (1.54–1.78) | 404 | 1.69 (1.51–1.90) |
| Troubled | 429 | 120 | 2.55 (2.04–3.18) | 60 | 3.21 (2.41–4.29) |
| No emotion | 391 | 81 | 1.85 (1.43–2.38) | 31 | 1.87 (1.28–2.74) |
| Antenatal possible mental illness (K6 score ≥ 13) (n = 3125) | | | | |
| Very happy | 1481 | 761 | Ref | 431 | Ref |
| Unintended but happy | 980 | 558 | 1.13 (0.95–1.34) | 341 | 1.19 (0.99–1.43) |
| Unintended and confused | 520 | 330 | 1.44 (1.16–1.79) | 209 | 1.47 (1.18–1.83) |
| Troubled | 106 | 66 | 1.25 (0.81–1.91) | 52 | 1.97 (1.30–3.00) |
| No emotion | 38 | 17 | 0.74 (0.37–1.47) | 13 | 1.24 (0.60–2.55) |

*a Adjusted for mother’s age, parity, marital status, smoking, mother’s education, household income, intimate partner violence, history of antidepressant use, and residential area*
which negative feelings or antenatal possible mental illnesses may affect the risk of PPD, the bonding of mother to fetus may play a role. An association between anxiety during pregnancy and risk of PPD was shown to be mediated by bonding failure (Kokubu et al. 2012). Considering mother-to-infant bonding, which comprises two factors; “anger and rejection” and “lack of affection” (Cattell 1966; Taylor et al. 2005), feeling troubled by being pregnant may correspond to “anger and rejection” component, and feeling no emotion may correspond to “lack of affection” component. Bonding failure between mother and fetus may persist after childbirth.

The major strengths of this study include a cohort study with a large sample size, in which the information on pregnancy intention and antenatal possible mental illness was collected during early pregnancy, precluding the possibility of recall bias. We adjusted for potential confounding variables such as maternal demographic characteristics, socioeconomic factors, and antenatal possible mental illness. Another strength is that the outcome was shown as both PPD with EPDS scores ≥ 9 and ≥ 12, and was evaluated during postpartum 1 month. The findings of this study may be useful to prevent and control PPD through the early detection of high-risk individuals. Antenatal screening for PPD through a questionnaire on feelings toward being pregnant is possible using antenatal regular check-ups at obstetrics clinics/hospitals or at local municipal offices issuing mother and child health handbooks.

This study is one of the few studies that demonstrate the association between feelings toward being pregnant and risk of PPD. However, several limitations should be addressed. First, the intention and feelings were not assessed separately. The questionnaire had missed some combinations such as unintended but very happy pregnancies, and intended but troubled pregnancies. Second, the questionnaire on pregnancy intention and feelings toward being pregnant was not validated. However, it is logically difficult because of no measurement golden standards for the comparison. Third, our measurements, EPDS and K6, are self-reported and not diagnosed by psychiatrists. However, EPDS and K6 are commonly used in research and are well-validated, reliable measurement; therefore, the impact of this error is expected to be small. Fourth, residual confounding could have occurred from unmeasured confounding variables, such as mothers’ chronic diseases.

In conclusion, our findings show that women whose pregnancy was unintended but felt happy had an increased risk of PPD. Women who regarded their pregnancies as unintended and felt confused, felt troubled, or had no specific emotion were also associated with an increased risk of PPD. These high-risk women should be regarded as targets for the early detection and prevention of PPD.

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Compliance with ethical standards

Conflict of interest Author Sachiko Baba, Author Takashi Kimura, Author Satoyo Ikehara, Author Kaori Honjo, Author Ehab S Eshak, Author Takuyo Sato, and Author Hiyoriy Iso declare that they have no conflict of interest.

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