

- Most previous studies on postpartum depression (PPD) risk factors are based on Western populations, which cannot be generalized to non-Western cultures.
- Based on a longitudinal population-based sample from Japan, we found that negative feelings about pregnancy, combined breast and bottle feeding, first-time motherhood, motherhood 24 years old, perceived maternal mental illness before pregnancy, and lack of social support were all significantly associated with PPD at three months after delivery.
- These risk factors should be identified and the mothers should be offered a suitable intervention, in order to prevent the development of PPD.

Abstract

Background: Postpartum depression (PPD) negatively impacts maternal health, parenting and development of children. Most previous studies on PPD risk factors are based on Western populations. Additionally, little is known about the association between psychosocial factors during early pregnancy period and PPD. We aimed to identify early risk factors for PPD until three months after delivery using a longitudinal population-based sample from Japan.

Methods: The data was collected from 1050 mothers at four time points: first trimester, after the birth, and one and three months post-delivery. Mothers who had a Japanese Edinburgh Postnatal Depression Scale (EPDS) cutoff score above 9 at 1 or 3 months after delivery were recognized as having PPD (n = 91/8.7%).

Results: Negative feelings about pregnancy, combined breast and bottle feeding, first-time motherhood, motherhood 24 years old, perceived maternal mental illness before pregnancy, and lack of social support were all significantly associated with PPD at 3 months after delivery.

Limitations: The data was collected from one city in Japan, which limits the generalization of the findings. Additionally, PPD was assessed by an EPDS questionnaire, and not by a clinical interview.

Conclusions: Even after controlling for the perceived mental illness before pregnancy, several risk factors as early as in the first trimester were associated with PPD. These risk factors should be identified and the mothers should be offered a suitable intervention, in order to prevent the development of PPD.

Key words

Postpartum depression; population based longitudinal study; risk factor

Early risk factors for postpartum depression: a longitudinal Japanese population-based study

Mami Nakano¹, Andre Sourander², Terhi Luntamo², Chudal Roshan², Norbert Skokauskas³, Hitoshi Kaneko⁴

1 Graduate School of Education and Human Development, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Japan 464-8601, Japan

2 Research Center for Child Psychiatry, University of Turku, Lemminkäisenkatu 3/Teutori 3rd Floor, Turku, 20014, Finland

3 Centre for Child and Adolescent Mental Health and Child Protection, Faculty of Medicine, NTNU, NO-7491, Trondheim, Norway

4 Psychological Support and Research Center for Human Development, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan

E-mail address:

Mami Nakano: nakano.mami@nagoya-u.jp

Terhi Luntamo: tetulu@utu.fi

Roshan Chudal: roshan.chudal@utu.fi

Norbert Skokauskas: norbert.skokauskas@ntnu.no

Andre Sourander: andsou@utu.fi

Hitoshi Kaneko: kaneko@cc.nagoya-u.ac.jp¹

¹ Corresponding author:

Hitoshi Kaneko
Psychological Support and Research Center for Human Development,
Nagoya University, 464-8601, Japan
Phone: +81527892665, E-mail: kaneko@cc.nagoya-u.ac.jp

1 Introduction¹

2 Postpartum depression (PPD) is defined as a major depressive episode that begins
3 within 4 weeks after delivery according to the Diagnostic and Statistical Manual of
4 Mental Disorders (DSM-5; American Psychiatric Association 2013). However in
5 clinical practice, depression within one year after delivery has been recognized as PPD
6 (O'hara & McCabe, 2013). Mothers with PPD often exhibit sadness, loss of interest and
7 joy, difficulty in concentrating and remembering, feelings of guilt and helplessness,
8 changes in appetite, and sleep disturbances (American Psychiatric Association 2013).

9 PPD may negatively impact maternal health, parenting and subsequently the
10 development of children. It can result in higher risk of maternal suicidal attempt and
11 completed suicide (Weng et al, 2016), abusive parenting (Sagami et al., 2004), poor
12 mother-infant interaction (Righetti-Veltama et al., 2002; Væver et al., 2015) and
13 infanticide (Krischer et al., 2007). In addition, it can result in negative sequelae for the
14 offspring including delayed cognitive development (Brand & Brennan, 2009),
15 behavioral problems (Avan et al, 2010; Murray et al., 2011), and even suicidal ideation
16 (Hammerton et al, 2016). PPD affects a significant number of mothers, children and
17 families, as the global prevalence of PPD has been reported to range from 3% in
18 Singapore to 38% in Chile (Hahn-Holbrook et al., 2018). PPD is a common
19 phenomenon in Japan, with rates reported ranging from 10.3% to 27% (~~Kitamura et al.,~~
20 ~~2006;~~ Miyake et al., 2006; Sagami et al., 2004; Ueda et al., 2006; Yamashita et al.,
21 2000). Therefore, identifying risk factors for PPD is important for earlier detection and
22 prevention of negative consequence of PPD in Japan.

¹ Abbreviations: Postpartum depression(PPD); Edinburgh Postnatal Depression Scale (EPDS)

1 Risk factors for PPD, reported in earlier studies, include unwanted pregnancy (Csatordai
2 et al., 2007), the history of depression (Silverman et al., 2018), poor marital relationship
3 (Azale et al., 2018), cesarean delivery (Silverman et al., 2017), preterm delivery,
4 (Silverman et al., 2017), and poor social support (Baumgartner et al., 2016). However,
5 there are still some gaps in the literature on the psychosocial risk factors for PPD. First,
6 the majority of population-based studies have been conducted in Western countries and
7 cannot be generalized to non-Western cultures. Second, relatively little is known about
8 the psychosocial risk factors for PPD during the first trimester of pregnancy (Kirkan et
9 al., 2015; Lee et al., 2007; Muchanga et al., 2017), as in most previous studies,
10 information on risk factors was collected only later, typically during the last trimester.
11 Studying early risk factors is essential as pregnancy is a valuable period for
12 implementing successful psychological interventions to prevent adverse outcomes.
13 Third, most studies have used cross-sectional designs, and only a few studies have
14 assessed risk factors for PPD based on longitudinal design (Asano et al., 2014;
15 Matsumoto et al., 2011; Watanabe et al., 2008). An important limitation in cross
16 sectional research is that mothers who do not have PPD at the time of assessment could
17 develop PPD later (Furumura et al., 2012; Hayakawa et al., 2012; Ishikawa et al., 2011).
18 Additionally, retrospective information about the mother's well-being may not be
19 reliable because of recall bias.

20 The aim of this study was to investigate the prenatal and postnatal risk factors associated
21 with PPD up to three months after delivery in a Japanese urban population based study
22 using routinely collected data in maternal and child health care city services. In
23 accordance with previous studies conducted mostly in Western countries (Davey et al.,
24 2011; Dias & Figueiredo, 2015; Räisänen et al., 2013; Robertson et al., 2004; Sword et

1 al., 2011; Vigod et al., 2010), we hypothesized that maternal negative feelings about
2 pregnancy, maternal mental illness before pregnancy, and social support would be
3 associated with PPD.

4 **Method**

5 *Procedure*

6 The present study is a longitudinal, citywide population-based study, conducted as a
7 part of the routine work by the maternal and child health care services in Hekinan City,
8 Aichi prefecture, Japan from July 2013 to June 2015 during which the population of
9 Hekinan City was about 70,000. In Japan, public health centres in all municipalities
10 provide continuous support to women and their families based on Maternal and Child
11 Health Act since 1965. The present study followed the normal pattern of collecting
12 information on depressive symptoms in public health centres. The Edinburgh Postnatal
13 Depression Scale (EPDS) was provided to all mothers to be filled at the time of two
14 check-ups after delivery; one month and three months. The health care personnel
15 provided the information sheet on the study and the EPDS to the mothers. With the
16 mothers informed consent, their answers could be used in the study.

17 The data were collected at four time points: 1) from pregnancy notification forms
18 submitted during the 11th week of gestation, 2) from birth registration forms submitted
19 within 14 days after delivery, 3) during home visits one month after delivery, and 4) at
20 the infant's health check-up three months after delivery. EPDS were collected at two
21 instances after the delivery; one month and three months.

22 All procedures performed in this study have been approved by the ethical committee at
23 the Graduate School of Education and Human Development, Nagoya University, Japan

1 (Reference number: 490). Information on participation in the study was provided in the
2 questionnaire. Informed consent to participate in this study was obtained from all
3 individual participants before including them in the study. Details of data collection
4 have been reported previously (Nakano et al., 2019).

5

6 ***Participants***

7 The original cohort included 1163 mothers who came to the public health centre for
8 their infant's health check-up 3 months after delivery. Maternal inclusion criteria were
9 as follows: (1) Japanese, (2) carrying a single fetus and (3) Edinburgh Postnatal
10 Depression Scale (EPDS) (Cox et al. 1987; Okano et al. 1996) was completed at least
11 once, at one month or three months after delivery. A total of 1050 (90.28%) mothers
12 were included in the analysis. One hundred and thirteen (9.71%) mothers were excluded
13 because seven of them (0.60%) had twins, fifty-eight of them (4.99%) were not
14 Japanese, and forty-eight of them (4.13%) did not complete the EPDS at either one
15 month or three months after giving birth.

16 The mean age of the mothers was 29.95 years, with a standard deviation (SD) of 5.08
17 (range 16-44 years) and the mean gestational age was 38.96 weeks (SD 1.36, range 33-
18 41 weeks). Less than half of the participants (n = 424, 41.90%) were first-time mothers,
19 and just over half of the babies were male (n = 543, 52.62%).

20

21 ***Measurements***

22 *Edinburgh Postnatal Depression Scale (EPDS)*

23 Edinburgh Postnatal Depression Scale (Cox et al., 1987; Okano, 1996) was used to
24 assess maternal PPD at one and three months after delivery. The EPDS is a self-rating

1 scale that includes 10 items scored from 0 (~~no, not at all~~) to 3 (~~yes, all the time~~). A
2 higher score of EPDS indicates greater depression possibility. A different cut-off score
3 has been recommended in different cultural groups (Gibson et al., 2009) for measuring
4 PPD. In Japan, a cut-off score ≥ 9 has been adapted and generally used to identify PPD
5 (Miyake et al., 2006; Okano, 1996; Sagami et al., 2004; Ueda et al., 2006; Yamashita et
6 al., 2000), as Japanese women are reluctant to disclose their negative mood (Yoshida et
7 al., 1997). The scale has a high internal consistency (Cronbach's alpha 0.87) and good
8 construct validity (Cox et al., 1987). The Japanese version of the EPDS has been
9 reported to have good validity, sensitivity (0.82) and specificity (0.95) (~~Okano, 1996;~~
10 Yamashita et al., 2000). EPDS was collected at one month and three months after the
11 delivery by a public health nurse or other trained health care personnel. In this study,
12 mothers who exceeded the EPDS cut-off score of ≥ 9 at least once (one month or three
13 months after delivery) were identified as having PPD. Public health nurses started
14 providing individual support to mothers who needed it based on the score of EPDS,
15 which are different from diagnostic interviews.

16

17 *Additional study variables*

18 A pregnancy notification form was used to obtain sociodemographic and some other
19 information including the mother's age (≤ 24 , 25-34 or ≥ 35 years), parity (primipara or
20 multipara), perceived mental illness before pregnancy (Have you suffered from a
21 disease in the past or are currently getting treated for one (Disease name: mental illness
22 (depression etc.)) (yes or no), feelings at the moment of discovering the pregnancy
23 (delighted or negative feelings; i.e. unintended but happy, confused because unintended
24 or worried), social support (yes or no). The type of birth (vaginal delivery; cesarean

1 section; assisted delivery, i.e. vacuum extraction or forceps delivery), and infant birth
2 weight ($\geq 2500\text{g}$ or $< 2500\text{g}$) were asked on the birth registration form. Childcare
3 support (yes or no) was asked during the home visit one month after delivery.
4 Gestational weeks (≥ 37 weeks or < 37 weeks), feeding style (only breastfeeding, only
5 bottle-feeding or combined breast and bottle feeding), maternal health after delivery
6 (problems or no problems) and maternal employment status during the antenatal period
7 (employed or unemployed) were asked during the infant checkup three months after
8 delivery. As only a few participants reported having no social support during the
9 pregnancy ($n = 11$) or having no child-care support after delivery ($n = 6$), participants
10 who answered either no social support in pregnancy or no childcare support after
11 delivery were categorized as “no social support”.

12

13 *Statistical Analysis*

14 Univariate and multivariate logistic regression analyses were conducted to examine the
15 risk factors of PPD. The association between exposures and PPD was determined by
16 odds ratios (ORs) with 95% confidence intervals (95% CIs). First, a univariate analysis
17 was carried out to determine independent variables to be selected in the multivariate
18 analysis. All variables with a significance level of $p < 0.10$ in the univariate analysis
19 were included in the multivariate analysis. Second, a multivariate analysis was
20 conducted to identify the association between PPD and variables found to be significant
21 in the univariate analysis. The level of statistical significance in the final analysis was
22 $p < 0.05$. All statistical analyses were carried out using SPSS 23.0.

23

24 **Results**

1 In our study, 8.9% (n = 93) of the 1,050 mothers had had PPD symptoms above the cut-
2 off point (cut-off score ≥ 9) at least once (one month or three months after delivery). Out
3 of these 93 mothers, 29.0 % (n=27) had scored above the cut-off at both time points, i.e
4 at one month and 3 month after delivery. 42.0% (n=39) had scored above the cut-off
5 point only at 1 month follow-up while 29.0% (n=27) only at 3 month follow-up. The
6 prevalence of PPD at each instance was 6.3% (n = 66) of the 1,046 mothers at one
7 month after delivery, and 5.1% (n = 54) of the 1,049 mothers at three months after
8 delivery. Table 1 shows the frequencies of each variable investigated and the results of
9 the univariate and multivariate analyses. The risk factors associated with PPD in
10 multivariate analysis were negative feelings about pregnancy (OR=2.07, 95% CI=1.28-
11 3.36), primipara mother (OR=2.01, 95% CI=1.21-3.35), maternal age under 24 years
12 (OR=2.43, 95% CI=1.37-4.30), maternal mental illness before pregnancy (OR=4.84,
13 95% CI=2.09-11.19), combined breast and bottle feeding (OR=1.80, 95% CI=1.01-
14 3.05) and lack of social support (OR=4.93, 95% CI=1.54-15.74). Low birth weight and
15 only bottle-feeding were associated with PPD in the univariate analysis but did not
16 remain significant when adjusted with all other variables.

17

18 **Discussion**

19 The main findings of the present longitudinal study were that maternal negative feelings
20 about pregnancy during the first trimester, combined bottle and breast feeding, being a
21 mother for the first time, mother's young age, mental problems before pregnancy, and
22 lack of social support were independently associated with PPD.

23 The finding that negative feelings about pregnancy when the mother discovered being

1 pregnant was associated with PPD is in line with previous studies (Kokubu et al., 2012;
2 Limlomwongse & Liabsuetrakul, 2006). Previous studies have suggested that mothers
3 who have negative feelings about their pregnancy are more likely to have subsequent
4 issues during pregnancy, such as maternal antenatal depression (Kitamura et al., 2006)
5 and impaired maternal bonding toward their fetus (Hassan & Hassan, 2017). It is
6 important to note that in previous Japanese studies, negative feelings when discovering
7 being pregnant were assessed in last trimester while in the present study this
8 information was collected in the first trimester, thus minimizing the recall bias. A
9 plausible explanation for the association between negative feelings about pregnancy and
10 PPD is that negative feelings and PPD may both be associated with other risk factors
11 such as low socioeconomic status (Dolbier et al., 2013; Goyal et al., 2010), family and
12 relational problems, and partner's mental health problems, such as depression and
13 substance use (Nishimura & Ohashi, 2010; Tyrlik et al., 2013).

14 Combined bottle and breast feeding were independently associated with PPD, whereas
15 bottle feeding alone did not independently associate with PPD in the final analysis. One
16 possible explanation for the results could be that breastfeeding was a protective factor
17 against PPD. Previous studies have shown several positive effects of breastfeeding on
18 the mother's health. Breastfeeding reduced maternal perceived anxiety, stress, and
19 negative moods (Groër, 2005). Furthermore, breastfeeding promotes mother-infant
20 interaction (Bigelow et al., 2014) including physical contact, gazing (Lavelli & Poli,
21 1998), and maternal responsiveness (Ventura, 2017). Another plausible explanation
22 might be that feeding style is the consequence of depression; that is, the depressive
23 mothers have difficulty providing sufficient breast milk to their infants. Previous studies
24 reported that depressive mothers have a lower intensity or early cessation of

1 breastfeeding (Dennis & McQueen, 2007; Gaffney et al., 2014). Maternal stress and
2 depressive symptoms may negatively affect lactation and the mother's self-efficacy in
3 breastfeeding (Haku, 2007; Zubaran & Foresti, 2013). The other explanation is that
4 there might be confounding factors regarding the association between combined bottle
5 and breastfeeding with PPD. A Japanese study (Maehara et al. 2017) reported higher
6 child-related stress among mothers using combined feeding compared to mothers using
7 only breastfeeding. Additionally, combined feeding style was associated with shorter
8 hours of night-time sleep, possibly due to greater time spent and practical burden in
9 providing feedings, as well as higher levels of fatigue (Maehara et al. 2017). In any case,
10 our findings may be due to small number of mothers regarded as PPD using only bottle
11 feeding. In fact, 6.7% of the breastfeeding mothers were regarded as PPD (n=45); this
12 rate was lower than both 12.5% of combined bottle and breastfeeding mothers (n=29)
13 and 13.3% of only bottle-feeding mothers (n=19).

14 Previous studies are inconsistent about the association between parity and risk of PPD.
15 In the present study, PPD was associated with primipara motherhood. Accordingly,
16 previous Japanese studies reported that being a mother for the first time increased the
17 risk of PPD (~~Akman et al., 2007~~; Asano et al., 2014; Iwata et al., 2016; Satoh et al.,
18 2009). However, some previous studies showed no significant association between
19 parity and PPD (Dietz et al., 2007; Wenzel et al., 2005) while some reported that
20 primiparity is associated with lower odds of depressive symptoms (Dørheim et al.,
21 2007; Figueiredo & Conde, 2011; Skari et al., 2002). The association between being a
22 mother for the first time and PPD might be explained by the challenging situation of
23 being first-time mothers, including more postpartum stress, concerns about maternal
24 role attainment and poor sleep quality when compared to second-time mothers

1 (Dørheim et al., 2009; Hung, 2007). Another explanation could be that mothers who
2 have had a depressive experience after the first delivery are less motivated to have more
3 children (Di Florio et al., 2014).

4 Younger maternal age was associated with the risk of developing PPD later. Both young
5 age (Milgrom et al., 2008; Mori et al., 2011; Sword et al., 2011; Zaidi et al., 2017) and
6 advanced age (Bell et al., 2016; Matsumoto et al., 2011; Mori et al., 2011; Muraca &
7 Joseph, 2014) have been associated with a higher risk of PPD in some studies, while
8 others have shown no association (Asano et al., 2014; Green et al., 2006; Kitamura et
9 al., 2006). One possibility is that young mothers are more likely to have psychosocial
10 problems, such as financial instability, lower education, and unstable marital status,
11 which also are possible risk factors for PPD (Muraca & Joseph, 2014; Seimyr et al.,
12 2004).

13 Consistent with previous research findings, both perceived maternal mental illness
14 before pregnancy and lack of social support were associated with PPD. Both low social
15 support and a history of mental illness are reported to be important risk factors for PPD
16 (Okubo et al., 2007; O'hara & McCabe, 2013; Sagami et al., 2004). In the present study,
17 the definition of low social support was strict, indicating that according to the mother's
18 report, she did not have anyone supporting her. Mothers with no social support might
19 have a poor relationship with their partner, family, and friends and may not perceive
20 receiving support from the health or social services. Low social support may be
21 associated with the experience of loneliness, thereby increasing challenges in parenting
22 the infant (Hudson et al., 2000). PPD may adversely affect the perception of
23 interpersonal relationships (Leskelä et al., 2008; Senturk et al., 2017) and mothers with

1 PPD may exaggerate the lack of social support.

2 **Strengths and limitations**

3 The strengths of the study are that it includes a longitudinal population-based design in
4 a non-Western country with low attrition rate, collection of information in early
5 pregnancy, and assessment of maternal depression at two time points. However, there
6 are several limitations to be considered when interpreting the results. First, the data was
7 collected from one city in Japan, which limits the generalization of the findings. About
8 4% of the mothers were not included in the analysis because they moved out of Hekinan
9 City or did not want to answer the EPDS questionnaire. Also, the overall prevalence of
10 EPDS > 9 of 8.9% in this study was much lower than that of the previous studies which
11 ranged from 14.0 to 27.0% (Miyake et al., 2006; Sagami et al., 2004; Ueda et al., 2006;
12 Yamashita et al., 2000). The study design of this study differs from that of previous
13 studies. Data were collected by voluntary participation in previous studies, whereas this
14 study used data collected from the Maternal and Child Health Act, ensuring
15 participation of over 90% of mothers who live in Hekinan city. Therefore, possible
16 participation bias in previous studies could explain the variation of prevalence rate in
17 this study. We believe that our sampling method contributes to a more accurate
18 description of the issues and adds new knowledge to the current status. Second, PPD
19 was assessed by an EPDS questionnaire, and not by a clinical interview. However,
20 EPDS has been commonly used, especially in large population samples to measure pre-
21 and postnatal depression. In an earlier Japanese study, the sensitivity of the EPDS for
22 measuring PPD was 0.82 and specificity 0.95 (Yamashita et al. 2000). Third,
23 unfortunately, the study did not include some important factors known to be associated

1 with postnatal depression. Although we inquired about maternal mental illnesses before
2 pregnancy, maternal depression during pregnancy, in addition to some other factors,
3 issues such as the family background with regard to mental health disorders and
4 personality and attachment characteristics of the mother were not assessed. Therefore,
5 the possible effects of these factors on PPD were not studied. It is also likely that the
6 association between some of the risk factors studied here and PPD are confounded or
7 mediated by additional risk factors mentioned above.

8 **Conclusions**

9 Risk factors of PPD have been studied extensively, but mainly in Western societies, and
10 the present study extends the earlier findings into Japanese society. Mothers who have
11 negative feelings about pregnancy should be identified at an early stage because they
12 are at higher risk of later PPD. Mothers who exclusively breastfeed have lower odds of
13 PPD. The result is in line with the current practices to support mothers to breastfeed.
14 Mothers with primipara, low social support, young age, and history of mental health
15 problems have an increased probability of having PPD. Assessing the risk factors by
16 health care professionals may help identify mothers at a higher risk of developing PPD
17 at an early stage of pregnancy when there is still enough time before delivery. Effective
18 interventions, such as counseling, should be considered for mothers at risk of
19 developing PPD (US preventive Services Task Force, 2019).

20 **References**

21 American Psychiatric Association, 2013. Diagnostic and statistical manual of mental
22 disorders, fifth ed. American Psychiatric Pub.

- 1 Akman, C., Uguz, F., Kaya, N., 2007. Postpartum-onset major depression is associated
2 with personality disorders. *Compr Psychiatry*. 48, 343-347.
3 <https://doi.org/10.1016/j.comppsy.2007.03.005>.
- 4 Asano, R., Tsuchiya, K. J., Takei, N., Harada, T., Kugizaki, Y., Nakahara, R.,
5 Nakayasua, C., Okumuraa, A., Suzuki, Y., Takagaia, S., Mori, N., 2014.
6 Broader autism phenotype as a risk factor for postpartum depression:
7 Hamamatsu Birth Cohort (HBC) Study. *Res Autism Spect Dis*. 8, 1672-1678.
8 <https://doi.org/10.1016/j.rasd.2014.08.010>.
- 9
- 10 Avan, B., Richter, L. M., Ramchandani, P. G., Norris, S. A., Stein, A., 2010. Maternal
11 postnatal depression and children's growth and behaviour during the early years
12 of life: exploring the interaction between physical and mental health. *Arch Dis*
13 *Child*. 95, 690-695. <http://dx.doi.org/10.1136/adc.2009.164848>.
- 14
- 15 ~~Aydin, N., Inandi, T., Yigit, A., & Hodoglugil, N. N. S., 2004. Validation of the Turkish~~
16 ~~version of the Edinburgh Postnatal Depression Scale among women within their first~~
17 ~~postpartum year. *Social psychiatry and psychiatric epidemiology*, 39(6), 483-486.~~
18 ~~<https://doi.org/10.1007/s00127-004-0770-4>.~~
- 19
- 20 Azale, T., Fekadu, A., Hanlon, C., 2018. Postpartum depressive symptoms in the
21 context of high social adversity and reproductive health threats: a population-
22 based study. *Int J Ment Health Sys*. 12, 42. [https://doi.org/10.1186/s13033-018-](https://doi.org/10.1186/s13033-018-0219-x)
23 [0219-x](https://doi.org/10.1186/s13033-018-0219-x).
- 24
- 25 Baumgartner, J. N., Parcesepe, A., Mekuria, Y. G., Abitew, D. B., Gebeyehu, W.,
26 Okello, F., Shattuck, D., 2016. Correlates of postpartum common mental
27 disorders: results from a population-based study in Amhara region, Ethiopia.
28 *Arch Womens Ment Health*. 19, 937-942. [https://doi.org/10.1007/s00737-016-](https://doi.org/10.1007/s00737-016-0617-5)
29 [0617-5](https://doi.org/10.1007/s00737-016-0617-5).
- 30
- 31 Bell, A., Carter, C., Davis, J., Golding, J., Adejumo, O., Pyra, M., Connelly, JJ., Rubin,
32 L., 2016. Childbirth and symptoms of postpartum depression and anxiety: a
33 prospective birth cohort study. *Arch Womens Ment Health*. 19, 219-227.
34 <https://doi.org/10.1007/s00737-015-0555-7>.
- 35
- 36 Bigelow, A. E., Power, M., Gillis, D. E., Maclellan-Peters, J., Alex, M., McDonald, C.,
37 2014. Breastfeeding, skin-to-skin contact, and mother–infant interactions over
38 infants' first three months. *Infant Ment Health J*. 35, 1, 51-62.
39 <https://doi.org/10.1002/imhj.21424>.
- 40
- 41 Brand, S. R., Brennan, P. A., 2009. Impact of antenatal and postpartum maternal mental
42 illness: how are the children?. *Clin Obstet Gynecol*. 52, 441-455.
43 <https://doi.org/10.1097/GRF.0b013e3181b52930>.
- 44
- 45 Cox, J. L., Holden, J. M., Sagovsky, R., 1987. Detection of postnatal depression.
46 Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J*
47 *Psychiatry*. 150, 782-786. <https://doi.org/10.1192/bjp.150.6.782>.

- 1
2 Csator dai, S., Kozinszky, Z., Devosa, I., Tóth, É., Krajcsi, A., Sefcsik, T., Pál, A., 2007.
3 Obstetric and sociodemographic risk of vulnerability to postnatal depression.
4 Patient Educ Couns. 67, 84-92. <https://doi.org/10.1016/j.pec.2007.02.004>.
5
- 6 Davey, H. L., Tough, S. C., Adair, C. E., Benzies, K. M., 2011. Risk factors for sub-
7 clinical and major postpartum depression among a community cohort of
8 Canadian women. *Matern Child Health J.* 15, 866-875.
9 <https://doi.org/10.1007/s10995-008-0314-8>.
10
- 11 Dennis, C. L., McQueen, K., 2007. Does maternal postpartum depressive
12 symptomatology influence infant feeding outcomes?. *Acta Paediatr.* 96, 590-594.
13 <https://doi.org/10.1111/j.1651-2227.2007.00184.x>
14
- 15 Di Florio, A., Jones, L., Forty, L., Gordon-Smith, K., Blackmore, E. R., Heron, J.,
16 Craddock, N., Jones, I., 2014. Mood disorders and parity—A clue to the aetiology
17 of the postpartum trigger. *J Affect Disord.* 152, 334-339.
18 <https://doi.org/10.1016/j.jad.2013.09.034>.
19
- 20 Dias, C. C., Figueiredo, B., 2015. Breastfeeding and depression: a systematic review of
21 the literature. *J Affect Disord.* 171, 142-154.
22 <https://doi.org/10.1016/j.jad.2014.09.022>.
23
- 24 Dietz, P. M., Williams, S. B., Callaghan, W. M., Bachman, D. J., Whitlock, E. P.,
25 Hornbrook, M. C., 2007. Clinically identified maternal depression before, during,
26 and after pregnancies ending in live births. *Am J Psychiatry.* 164, 1515-1520.
27 <https://doi.org/10.1176/appi.ajp.2007.06111893>.
28
- 29 Dolbier, C. L., Rush, T. E., Sahadeo, L. S., Shaffer, M. L., Thorp, J., Investigators, C. C.
30 H. N., 2013. Relationships of race and socioeconomic status to postpartum
31 depressive symptoms in rural African American and non-Hispanic white women.
32 *Matern Child Health J.* 17, 1277-1287. <https://doi.org/10.1007/s10995-012-1123-7>.
33
34
- 35 Dørheim Ho-Yen, S., Tschudi Bondevik, G., Eberhard-Gran, M., Bjorvatn, B., 2007.
36 Factors associated with depressive symptoms among postnatal women in Nepal.
37 *Acta Obstet Gynecol Scand.* 86, 291-297.
38 <https://doi.org/10.1080/00016340601110812>.
39
- 40 Dørheim, S. K., Bondevik, G. T., Eberhard-Gran, M., Bjorvatn, B., 2009. Sleep and
41 depression in postpartum women: a population-based study. *Sleep.* 32, 847-855.
42 <https://doi.org/10.1093/sleep/32.7.847>.
43
- 44 Figueiredo, B., Conde, A., 2011. Anxiety and depression in women and men from early
45 pregnancy to 3-months postpartum. *Arch Womens Ment Health.* 14, 247-255.
46 <https://doi.org/10.1007/s00737-011-0217-3>.
47

- 1 Furumura, K., Koide, T., Okada, T., Murase, S., Aleksic, B., Hayakawa, N., Shiino, T.,
2 Nakamura, Y., Tamaji, A., Ishikawa, N., Ohoka, H., Usui, H., Banno, N., Morita,
3 T., Goto, S., Kanai, A., Masuda, T., Ozaki, N., 2012. Prospective study on the
4 association between harm avoidance and postpartum depressive state in a
5 maternal cohort of Japanese women. *Plos One*. 7, e34725.
6 <https://doi.org/10.1371/journal.pone.0034725>.
7
- 8 Gaffney, K. F., Kitsantas, P., Brito, A., Swamidoss, C. S., 2014. Postpartum depression,
9 infant feeding practices, and infant weight gain at six months of age. *J Pediatr*
10 *Health Care*. 28, 43-50. <https://doi.org/10.1016/j.pedhc.2012.10.005>.
11
- 12 Gibson, J., McKenzie - McHarg, K., Shakespeare, J., Price, J., & Gray, R., 2009. A
13 systematic review of studies validating the Edinburgh Postnatal Depression
14 Scale in antepartum and postpartum women. *Acta Psychiatrica Scandinavica*,
15 119(5), 350-364. <https://doi.org/10.1111/j.1600-0447.2009.01363.x>.
16
- 17 Goyal, D., Gay, C., & Lee, K. A., 2010. How much does low socioeconomic status
18 increase the risk of prenatal and postpartum depressive symptoms in first-time
19 mothers?. *Womens Health Issues*. 20, 96-104.
20 <https://doi.org/10.1016/j.whi.2009.11.003>.
21
- 22 Green, K., Broome, H., Mirabella, J., 2006. Postnatal depression among mothers in the
23 United Arab Emirates: socio-cultural and physical factors. *Psychol Health Med*.
24 11, 425-431. <https://doi.org/10.1080/13548500600678164>.
25
- 26 Groër, M. W., 2005. Differences between exclusive breastfeeders, formula-feeders, and
27 controls: a study of stress, mood, and endocrine variables. *Biol Res Nurs*. 7,
28 106-117. <https://doi.org/10.1177/1099800405280936>.
29
- 30 Haku, M., 2007. Breastfeeding: factors associated with the continuation of
31 breastfeeding, the current situation in Japan, and recommendations for further
32 research. *J Med Invest*. 54, 224-234. <https://doi.org/10.2152/jmi.54.224>.
33
- 34 Hammerton, G., Zammit, S., Thapar, A., Collishaw, S., 2016. Explaining risk for
35 suicidal ideation in adolescent offspring of mothers with depression. *Psychol*
36 *Med*. 46, 265-275. <https://dx.doi.org/10.1017%2FS0033291715001671>.
37
- 38 Hahn-Holbrook, J., Cornwell-Hinrichs, T., & Anaya, I., 2018. Economic and health
39 predictors of national postpartum depression prevalence: a systematic review,
40 meta-analysis, and meta-regression of 291 studies from 56 countries. *Frontiers*
41 *in psychiatry*, 8, 248. <https://10.3389/fpsy.2017.00248>.
42
- 43 Hassan, N. M. M., Hassan, F. M. A. E., 2017. Predictors of maternal fetal attachment
44 among pregnant women. *J Nurs Health Sci*. 6, 95-106.
45 <https://doi.org/10.1111/j.1524-475X.1996.00056.x>.
46

- 1 Hayakawa, N., Koide, T., Okada, T., Murase, S., Aleksic, B., Furumura, K., Shiino, T.,
2 Nakamura, Y., Tamaji, A., Ishikawa, N., Ohoka, H., Usui, H., Banno, N., Morita,
3 T., Goto, S., Kanai, A., Masuda, T., Ozaki, N., 2012. The postpartum depressive
4 state in relation to perceived rearing: a prospective cohort study. *Plos One*, 7,
5 e50220. <https://dx.doi.org/10.1371%2Fjournal.pone.0050220>.
6
- 7 Hudson, D. B., Elek, S. M., Campbell-Grossman, C., 2000. Depression, self-esteem,
8 loneliness, and social support among adolescent mothers participating in the
9 new parents project. *Adolescence*. 35, 445-53.
10
- 11 Hung, C.H., 2007. The psychosocial consequences for primiparas and multiparas.
12 *Kaohsiung J Med Sci*. 23, 352-360. [https://doi.org/10.1016/S1607-](https://doi.org/10.1016/S1607-551X(09)70421-8)
13 [551X\(09\)70421-8](https://doi.org/10.1016/S1607-551X(09)70421-8).
14
- 15 Ishikawa, N., Goto, S., Murase, S., Kanai, A., Masuda, T., Aleksic, B., Usui, H., Ozaki,
16 N., 2011. Prospective study of maternal depressive symptomatology among
17 Japanese women. *J Psychosom Res*. 71, 264-269.
18 <https://doi.org/10.1016/j.jpsychores.2011.02.001>.
19
- 20 Iwata, H., Mori, E., Tsuchiya, M., Sakajo, A., Maehara, K., Ozawa, H., Morita, A.,
21 Maekawa, T., Aoki, K., Tamakoshi, K., 2016. Predictors of depressive
22 symptoms in older Japanese primiparas at 1 month post - partum: A risk -
23 stratified analysis. *Jpn J Nurs Sci*. 13, 147-155.
24 <https://doi.org/10.1111/jjns.12099>.
25
- 26 Kirkan, T. S., Aydin, N., Yazici, E., Aslan, P. A., Acemoglu, H., Daloglu, A. G., 2015.
27 The depression in women in pregnancy and postpartum period: A follow-up
28 study. *Int J Soc Psychiatry*. 61, 343-349.
29 <https://doi.org/10.1177/0020764014543713>.
30
- 31 Kitamura, T., Yoshida, K., Okano, T., Kinoshita, K., Hayashi, M., Toyoda, N., Ito, M.,
32 Kudo, N., Tada, K., Kanazawa, K., Sakumoto, K., Satoh, S., Furukawa, T.,
33 Nakano, H., 2006. Multicentre prospective study of perinatal depression in
34 Japan: incidence and correlates of antenatal and postnatal depression. *Arch*
35 *Womens Ment Health*. 9, 121-130. <https://doi.org/10.1007/s00737-006-0122-3>.
36
- 37 Kokubu, M., Okano, T., Sugiyama, T., 2012. Postnatal depression, maternal bonding
38 failure, and negative attitudes towards pregnancy: a longitudinal study of
39 pregnant women in Japan. *Arch Womens Ment Health*. 15, 211-216.
40 <https://doi.org/10.1007/s00737-012-0279-x>.
41
- 42 Krischer, M. K., Stone, M. H., Sevecke, K., Steinmeyer, E. M., 2007. Motives for
43 maternal filicide: Results from a study with female forensic patients. *Int J Law*
44 *Psych*. 30, 191-200. <https://doi.org/10.1016/j.ijlp.2007.03.003>.
45

- 1 Lavelli, M., Poli, M., 1998. Early mother-infant interaction during breast-and bottle-
2 feeding. *Infant Behav Dev.* 21, 667-683. <https://doi.org/10.1016/S0163->
3 6383(98)90037-6.
4
- 5 Lee, A. M., Lam, S. K., Lau, S. M. S. M., Chong, C. S. Y., Chui, H. W., Fong, D. Y. T.,
6 2007. Prevalence, course, and risk factors for antenatal anxiety and depression.
7 *Obstet Gynecol.* 110, 1102-1112.
8 <https://doi.org/10.1097/01.AOG.0000287065.59491.70>.
9
- 10 Leskelä, U., Melartin, T., Rytälä, H., Sokero, P., Lestelä-Mielonen, P., Isometsä, E.,
11 2008. The influence of major depressive disorder on objective and subjective
12 social support: a prospective study. *J Nerv Ment Dis.* 196, 876-883.
13 <https://doi.org/10.1097/NMD.0b013e31818ec6cf>.
14
- 15 Limlomwongse, N., Liabsuetrakul, T., 2006. Cohort study of depressive moods in Thai
16 women during late pregnancy and 6–8 weeks of postpartum using the Edinburgh
17 Postnatal Depression Scale (EPDS). *Arch Womens Ment Health.* 9, 131-138.
18 <https://doi.org/10.1007/s00737-005-0115-7>.
19
20
- 21 Maehara, K., Mori, E., Iwata, H., Sakajo, A., Aoki, K., & Morita, A., 2017. Postpartum
22 maternal function and parenting stress: Comparison by feeding methods. *Int J*
23 *Nurs Pract.* 23 (S1): e12549. <https://doi.org/10.1111/ijn.12549>.
24
- 25 Matsumoto, K., Tsuchiya, K. J., Itoh, H., Kanayama, N., Suda, S., Matsuzaki, H., Iwata,
26 Y., Suzuki, K., Nakamura, K., Mori, N., Takei, N., 2011. Age-specific 3-month
27 cumulative incidence of postpartum depression: The Hamamatsu Birth Cohort
28 (HBC) Study. *J Affect Disord.* 133, 607-610.
29 <https://doi.org/10.1016/j.jad.2011.04.024>.
30
- 31 Milgrom, J., Gemmill, A. W., Bilszta, J. L., Hayes, B., Barnett, B., Brooks, Ericksen, J.,
32 Ellwood, D., Buist, A., 2008. Antenatal risk factors for postnatal depression: a
33 large prospective study. *J Affect Disord.* 108, 147-157.
34 <https://doi.org/10.1016/j.jad.2007.10.014>.
35
- 36 Miyake, Y., Sasaki, S., Tanaka, K., Yokoyama, T., Ohya, Y., Fukushima, W., Saito, K.,
37 Ohfuji, S., Kiyohara, C., Hirota, Y., Osaka Maternal and Child Health Study
38 Group., 2006. Dietary folate and vitamins B12, B6, and B2 intake and the risk of
39 postpartum depression in Japan: the Osaka maternal and child health study. *J*
40 *Affect Disord.* 96(1–2), 133-138. <https://doi.org/10.1016/j.jad.2006.05.024>.
41
- 42 Mori, T., Tsuchiya, K. J., Matsumoto, K., Suzuki, K., Mori, N., Takei, N., & Team, H.
43 S. 2011. Psychosocial risk factors for postpartum depression and their relation to
44 timing of onset: The Hamamatsu Birth Cohort (HBC) Study. *J Affect Disord.*
45 135, 341-346. <https://doi.org/10.1016/j.jad.2011.07.012>.
46

- 1 Muchanga, S. M. J., Yasumitsu-Lovell, K., Eitoku, M., Mbelambela, E. P., Ninomiya,
2 H., Komori, K., Tozin, R., Maeda, N., Fujieda, M., Suganuma, N., 2017.
3 Preconception gynecological risk factors of postpartum depression among
4 Japanese women: The Japan Environment and Children's Study (JECS). *J Affect*
5 *Disord.* 217, 34-41. <https://doi.org/10.1016/j.jad.2017.03.049>.
6
- 7 Muraca, G. M., Joseph, K., 2014. The association between maternal age and depression.
8 *J Obstet Gynaecol Can.* 36, 803-810. [https://doi.org/10.1016/S1701-](https://doi.org/10.1016/S1701-2163(15)30482-5)
9 [2163\(15\)30482-5](https://doi.org/10.1016/S1701-2163(15)30482-5).
10
- 11 Murray, L., Arteché, A., Fearon, P., Halligan, S., Goodyer, I., & Cooper, P., 2011.
12 Maternal postnatal depression and the development of depression in offspring up
13 to 16 years of age. *J Am Acad of Child Adolesc Psychiatry.* 50, 460-470.
14 <https://doi.org/10.1016/j.jaac.2011.02.001>.
15
- 16 Nakano, M., Upadhyaya, S., Chudal, R., Skokauskas, N., Luntamo, T., Sourander, A.,
17 Kaneko, H., 2019. Risk factors for impaired maternal bonding when infants are
18 3 months old: a longitudinal population based study from Japan. *BMC*
19 *psychiatry*, 19(1), 87. <https://doi.org/10.1186/s12888-019-2068-9>.
20
- 21 Nishimura, A., & Ohashi, K., 2010. Risk factors of paternal depression in the early
22 postnatal period in Japan. *Nurs Health Sci.* 12, 170-176. [https://doi.org/10.1111/j.1442-](https://doi.org/10.1111/j.1442-2018.2010.00513.x)
23 [2018.2010.00513.x](https://doi.org/10.1111/j.1442-2018.2010.00513.x).
24
- 25 O'hara, M. W., McCabe, J. E., 2013. Postpartum depression: current status and future
26 directions. *Annu Rev Clin Psychol.* 9, 379-407. [https://doi.org/10.1146/annurev-](https://doi.org/10.1146/annurev-clinpsy-050212-185612)
27 [clinpsy-050212-185612](https://doi.org/10.1146/annurev-clinpsy-050212-185612).
28
- 29 ~~Ohoka H, Koide T, Goto S, Murase S, Kanai A, Masuda T, et al., 2014. Effects of~~
30 ~~maternal depressive symptomatology during pregnancy and the postpartum period on~~
31 ~~infant-mother attachment. *Psychiatry Clin Neurosci.* 68(8), 631–639.~~
32 ~~[https://doi:10.1111/pen.12171](https://doi.org/10.1111/pen.12171).~~
33
- 34 Okano, T. 1996. Validation and reliability of a Japanese version of the EPDS (in
35 Japanese). *Arch Psychiatr Diagn Clin Eval.* 7, 525-533.
36
- 37 Okubo, N., Matsuoka, M., Misao, H., Mitsunashi, M., 2007. Birth experience and
38 postnatal depression: Women's negative evaluation as a risk factor. *Asian J Nurs.*
39 *10*, 257-264.
40
- 41 Räisänen, S., Lehto, S. M., Nielsen, H. S., Gissler, M., Kramer, M. R., Heinonen, S.,
42 2013. Fear of childbirth predicts postpartum depression: a population-based
43 analysis of 511 422 singleton births in Finland. *BMJ open.* 3, e004047.
44 <https://doi.org/10.1136/bmjopen-2013-004047>.
45

- 1 Righetti-Veltema, M., Conne-Perréard, E., Bousquet, A., Manzano, J., 2002.
2 Postpartum depression and mother–infant relationship at 3 months old. *J Affect*
3 *Disord.* 70, 291-306. [https://doi.org/10.1016/s0165-0327\(01\)00367-6](https://doi.org/10.1016/s0165-0327(01)00367-6).
4
- 5 Robertson, E., Grace, S., Wallington, T., Stewart, D. E., 2004. Antenatal risk factors for
6 postpartum depression: a synthesis of recent literature. *Gen Hosp Psychiatry.* 26,
7 289-295. <https://doi.org/10.1016/j.genhosppsy.2004.02.006>.
8
- 9 Sagami, A., Kayama, M., Senoo, E., 2004. The relationship between postpartum
10 depression and abusive parenting behavior of Japanese mothers: a survey of
11 mothers with a child less than one year old. *Bull Menninger Clin.* 68, 174-187.
12 <https://doi.org/10.1521/bumc.68.2.174.35951>.
13
- 14 Satoh, A., Kitamiya, C., Kudoh, H., Watanabe, M., Menzawa, K., Sasaki, H., 2009.
15 Factors associated with late post - partum depression in Japan. *Jpn J Nurs Sci.* 6,
16 27-36. <https://doi.org/10.1111/j.1742-7924.2009.00121.x>.
17
- 18 Seimyr, L., Edhborg, M., Lundh, W., Sjögren, B., 2004. In the shadow of maternal
19 depressed mood: experiences of parenthood during the first year after childbirth.
20 *J Psychosom Obstet Gynecol.* 25, 23-34.
21 <https://doi.org/10.1080/01674820410001737414>.
22
- 23 Senturk, V., Abas, M., Dewey, M., Berksun, O., Stewart, R., 2017. Antenatal depressive
24 symptoms as a predictor of deterioration in perceived social support across the
25 perinatal period: a four-wave cohort study in Turkey. *Psychol Med.* 47, 766-775.
26 <https://doi.org/10.1017/S0033291716002865>.
27
- 28 Silverman, M. E., Reichenberg, A., Savitz, D. A., Cnattingius, S., Lichtenstein, P.,
29 Hultman, C. M., Larsson, H., Sandin, S., 2017. The risk factors for postpartum
30 depression: A population - based study. *Depress Anxiety,* 34, 178-187.
31 <https://doi.org/10.1002/da.22597>.
32
- 33 Silverman, M. E., Smith, L., Lichtenstein, P., Reichenberg, A., Sandin, S., 2018. The
34 association between body mass index and postpartum depression: A population-
35 based study. *J Affect Disord.* 240, 193-198.
36 <https://doi.org/10.1016/j.jad.2018.07.063>.
37
- 38 Skari, H., Skreden, M., Malt, U. F., Dalholt, M., Ostensen, A. B., Egeland, T., Emblem,
39 R., 2002. Comparative levels of psychological distress, stress symptoms,
40 depression and anxiety after childbirth—a prospective population - based study
41 of mothers and fathers. *BJOG.* 109, 11541163. <https://doi.org/10.1111/j.1471-0528.2002.00468.x>.
42
- 43 ~~44 Smith-Nielsen, J., Matthey, S., Lange, T., & Væver, M. S., 2018. Validation of the~~
45 ~~Edinburgh Postnatal Depression Scale against both DSM-5 and ICD-10 diagnostic~~

- 1 ~~eriteria for depression. BMC psychiatry, 18(1), 393. [https://doi.org/10.1186/s12888-](https://doi.org/10.1186/s12888-018-1965-7)~~
2 ~~018-1965-7.~~
3
4 ~~Spinelli, M. G., 2004. Maternal infanticide associated with mental illness: prevention~~
5 ~~and the promise of saved lives. Am J Psychiatry. 161, 1548-1557.~~
6 ~~[https://doi.org/10.1176/appi.ajp.161.9.1548.](https://doi.org/10.1176/appi.ajp.161.9.1548)~~
7
8 Sword, W., Kurtz Landy, C., Thabane, L., Watt, S., Krueger, P., Farine, D., Foster, G.,
9 2011. Is mode of delivery associated with postpartum depression at 6 weeks: a
10 prospective cohort study. BJOG. 118, 966-977. [https://doi.org/10.1111/j.1471-](https://doi.org/10.1111/j.1471-0528.2011.02950.x)
11 [0528.2011.02950.x.](https://doi.org/10.1111/j.1471-0528.2011.02950.x)
12
13 Tyrlik, M., Konecny, S., Kukla, L., 2013. Predictors of pregnancy-related emotions. J
14 Clin Med Res. 5, 112-120. [https://doi.org/10.4021/jocmr1246e.](https://doi.org/10.4021/jocmr1246e)
15
16 Ueda, M., Yamashita, H., & Yoshida, K., 2006. Impact of infant health problems on
17 postnatal depression: pilot study to evaluate a health visiting system. Psychiatry
18 and clinical neurosciences, 60(2), 182-189. [https://doi.org/10.1111/j.1440-](https://doi.org/10.1111/j.1440-1819.2006.01484.x)
19 [1819.2006.01484.x.](https://doi.org/10.1111/j.1440-1819.2006.01484.x)
20
21 US preventive Services Task Force, 2019. Final Recommendation Statement
22 Perinatal Depression: Preventive Interventions.
23 [https://www.uspreventiveservicestaskforce.org/Page/Document/Recommendatio](https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/perinatal-depression-preventive-interventions)
24 [nStatementFinal/perinatal-depression-preventive-interventions](https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/perinatal-depression-preventive-interventions) (accessed 06Oct
25 2019)
26
27 Væver, M. S., Krogh, M. T., Smith - Nielsen, J., Christensen, T. T., Tharner, A., 2015.
28 Infants of depressed mothers show reduced gaze activity during mother-infant
29 interaction at 4 months. *Infancy*. 20, 445-454. [https://](https://doi.org/10.1111/infa.12082)
30 [doi.org/10.1111/infa.12082.](https://doi.org/10.1111/infa.12082)
31
32 Ventura, A. K., 2017. Associations between breastfeeding and maternal responsiveness:
33 a systematic review of the literature. *Adv Nutr*. 8, 495-510.
34 [https://doi.org/10.3945/an.116.014753.](https://doi.org/10.3945/an.116.014753)
35
36 Vigod, S. N., Villegas, L., Dennis, C. L., Ross, L. E., 2010. Prevalence and risk factors
37 for postpartum depression among women with preterm and low - birth - weight
38 infants: a systematic review. *BJOG*. 117, 540-550.
39 [https://doi.org/10.1111/j.1471-0528.2009.02493.x.](https://doi.org/10.1111/j.1471-0528.2009.02493.x)
40
41 Watanabe, M., Wada, K., Sakata, Y., Aratake, Y., Kato, N., Ohta, H., Tanaka, K., 2008.
42 Maternity blues as predictor of postpartum depression: a prospective cohort
43 study among Japanese women. *J Psychosom Obstet Gynecol*. 29, 206-212.
44 [https://doi.org/10.1080/01674820801990577.](https://doi.org/10.1080/01674820801990577)
45

- 1 Weng, S.-C., Chang, J.-C., Yeh, M.-K., Wang, S.-M., Chen, Y.H., 2016. Factors
2 influencing attempted and completed suicide in postnatal women: A population-
3 based study in Taiwan. *Sci Rep.* 6, 25770. <https://doi.org/10.1038/srep25770>.
4
- 5 Wenzel, A., Haugen, E. N., Jackson, L. C., Brendle, J. R., 2005. Anxiety symptoms and
6 disorders at eight weeks postpartum. *J Anxiety Disord.* 19, 295-311.
7 <https://doi.org/10.1016/j.janxdis.2004.04.001>.
8
- 9 Yamashita, H., Yoshida, K., Nakano, H., Tashiro, N., 2000. Postnatal depression in
10 Japanese women - Detecting the early onset of postnatal depression by closely
11 monitoring the postpartum mood. *J Affect Dis.* 58, 145-154.
12 [https://doi.org/10.1016/S0165-0327\(99\)00108-1](https://doi.org/10.1016/S0165-0327(99)00108-1).
13
- 14 Yoshida, K., Marks, M. N., Kibe, N., Kumar, R., Nakano, H., & Tashiro, N., 1997.
15 Postnatal depression in Japanese women who have given birth in England. *J*
16 *Affect Disord*, 43(1), 69-77. [https://doi.org/10.1016/S0165-0327\(96\)01419-X](https://doi.org/10.1016/S0165-0327(96)01419-X).
17
- 18 Zaidi, F., Nigam, A., Anjum, R., Agarwalla, R., 2017. Postpartum Depression in
19 Women: A Risk Factor Analysis. *J Clin Diagn Res.* 11, QC13-QC16.
20 <https://doi.org/10.7860/JCDR/2017/25480.10479>.
21
- 22 Zubaran, C., Foresti, K., 2013. The correlation between breastfeeding self-efficacy and
23 maternal postpartum depression in southern Brazil. *Sex Reprod Healthc.* 4, 9-15.
24 <https://doi.org/10.1016/j.srhc.2012.12.001>.

Table 1: Frequencies of each variable and the results of univariate and multivariate analyses

Variable	N (%)		Univariate analysis	Multivariate ¹ analysis
	No PPD	PPD	OR (95%CI)	OR (95%CI)
Feelings about pregnancy (n = 992)				
Delighted	662 (93.11)	49 (6.89)	Reference	Reference
Negative feelings (unintended/worried)	243 (86.48)	38 (13.52)	2.11 (1.35-3.31)*	2.07 (1.28-3.36)*
Feeding style (n = 1,046)				
Only Breast feeding	626 (93.29)	45 (6.71)	Reference	Reference
Only Bottle feeding	124 (86.71)	19 (13.29)	2.13 (1.21-3.77)*	1.60 (0.82-3.00)
Breast and bottle feeding	203 (87.50)	29 (12.50)	1.99 (1.21-3.25)*	1.80 (1.01-3.05)*
Parity (n = 1,012)				
Multipara	550 (93.54)	38 (6.46)	Reference	Reference
Primipara	371 (87.50)	53 (12.50)	2.07 (1.34-3.20)*	2.01 (1.21-3.35)*
Mother's age (Years) (n = 1,031)				
≤ 24	133 (83.13)	27 (16.88)	2.64 (1.58-4.38)***	2.43 (1.37-4.30)*
25-34	610 (92.85)	47 (7.15)	Reference	Reference
≥ 35	197 (92.06)	17 (7.94)	1.12 (0.63-2.00)	1.00 (0.52-1.93)
Maternal mental illness before pregnancy (n = 1,030)				
No	914 (92.14)	78 (7.86)	Reference	Reference
Yes	25 (65.79)	13 (34.21)	6.09 (3.00-12.38)***	4.84 (2.09-11.19)*
Social support (n = 1,007)				
Yes	908 (91.7)	82 (8.3)	Reference	Reference
No	12 (70.6.7)	5 (29.4)	4.61 (1.59-13.42)*	4.93 (1.54-15.74)*
Birth weight (n = 1,032)				
≥ 2500g	880 (91.67)	80 (8.33)	Reference	Reference
< 2500g	61 (84.72)	11 (15.28)	1.98 (1.00-3.92)*	1.87 (0.90-3.87)

¹ The multivariate analysis comprises variables that were shown to be significantly associated with postpartum depression in the univariate analysis.

Infant's Sex (n = 1,032)				
Boy	500 (92.08)	43 (7.92)	Reference	Reference
Girl	441 (90.18)	48 (9.82)	1.23 (0.82-1.95)	1.49 (0.92-2.40)
Gestational weeks (n = 1,049)				
≥ 37 weeks	921 (91.28)	88 (8.72)	Reference	NA
< 37 weeks	35 (87.50)	5 (12.50)	1.50 (0.57-3.91)	NA
Employment status(n = 1,049)				
Employed	503 (90.79)	51 (9.21)	Reference	NA
Unemployed	453 (91.52)	42 (8.48)	0.91 (0.60-1.40)	NA
Birth type (n = 1,043)				
Virginal delivery	686 (91.22)	66 (8.78)	Reference	NA
Caesarean section	196 (89.91)	22 (10.09)	0.60 (0.21-1.70)	NA
Assisted delivery	69 (94.52)	4 (5.48)	1.16 (0.70-1.94)	NA
Maternal health after delivery(n = 1,046)				
Reported no problem	906 (91.24)	87 (8.76)	Reference	NA
Reported problem	47 (88.68)	6 (11.32)	1.33 (0.55-3.20)	NA

***<0.0001, **<0.001, *<0.05, +<0.10

N.A = Not applicable

Conflict of interests

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Author contributions

MN performed all the statistical analyses and wrote the first draft of the manuscript. HK supervised in designing and revised the paper critically. AS, TL, RC, NS, critically read and revised the manuscript. All authors participated in planning the statistical analyses and read and approved the final manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors

Acknowledgements

I wish to acknowledgment all staffs of the maternal and child health care services in Hekinan City, Aichi prefecture, Japan and all mothers who cooperated with this study.