



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



The effect of social restrictions, loss of social support, and loss of maternal autonomy on postpartum depression in 1 to 12-months postpartum women during the COVID-19 pandemic

Kanami Tsuno^{a,b,*}, Sumiyo Okawa^c, Midori Matsushima^d, Daisuke Nishi^{b,e}, Yuki Arakawa^f, Takahiro Tabuchi^g

^a School of Health Innovation, Kanagawa University of Human Services, Kanagawa, Japan

^b Department of Mental Health, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan

^c Institute for Global Health Policy Research, Bureau of International Health Cooperation, National Center for Global Health and Medicine, Tokyo, Japan

^d Faculty of Humanities and Social Sciences/R&D Center for Smart Wellness City Policies, University of Tsukuba, Ibaraki, Japan

^e Department of Public Mental Health Research, National Institute of Mental Health, National Center of Neurology and Psychiatry, Tokyo, Japan

^f Doctoral Program, Social Medicine, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan

^g Cancer Control Center, Osaka International Cancer Institute, Osaka, Japan

ARTICLE INFO

Keywords:

Anxiety
Coronavirus
Depressive symptoms
Edinburgh postnatal depression scale
Postpartum depression
Stress

ABSTRACT

Background: This study focused on postpartum women, who are one of the most vulnerable populations during the COVID-19 pandemic, aiming to reveal mental health consequences of social restrictions, loss of social support, and loss of autonomy.

Methods: We conducted a cross-sectional study for postpartum women in October 2020 in Japan ($N = 600$). The Edinburgh Postpartum Depression Scale (EPDS) was used to measure postpartum depression. The prevalence ratios were estimated by log-binomial regression models, adjusting for age, education, household income, residential area, parity, the timing of delivery, and a prior history of depression.

Results: The prevalence of postpartum depression was 28.7% (EPDS ≥ 9 , which is frequently used in Japan), 18.6% (≥ 11), and 13.1% (≥ 13). Social restrictions, including cancellation of home visits by healthcare professionals and cancellation of infant checkups or vaccinations, loss of support during pregnancy or after delivery, including loss of opportunities to consult with healthcare professionals or friends and cancellation of parents or other family members' visits to support, and loss of autonomy about delivery or breastfeeding, were associated with postnatal depression.

Conclusions: At least 13% of women who delivered and raised babies during the COVID-19 pandemic had postpartum depressive symptoms. COVID-19 related social restrictions and loss of social support from healthcare professionals, families, and friends were significantly associated with postpartum depression. In addition, loss of maternal autonomy in delivery and breastfeeding was associated with postpartum depression. The results indicate that both formal and informal support should not be limited to preventing postpartum depression during a pandemic.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has changed people's daily lives globally, imposing social restrictions on citizens to contain an infection and prevent the spread of the virus. On April 7,

2020, the Japanese government declared its first state of emergency in seven prefectures including Tokyo, and urged citizens to stay at home and avoid unnecessary travel, particularly from cities to rural areas, which are densely populated with older adults (Looi, 2020). Following an increase in untraceable cases, the declaration was expanded across

Abbreviations: COVID-19, coronavirus disease 2019; EPDS, Edinburgh Postpartum Depression Scale.

* Corresponding author at: School of Health Innovation, Kanagawa University of Human Services, Research Gate Building TONOMACHI 2, 3-25-10 Tonomachi, Kawasaki-ku, Kawasaki-shi, Kanagawa 210-0821, Japan.

E-mail address: ktsuno-ky@umin.ac.jp (K. Tsuno).

<https://doi.org/10.1016/j.jad.2022.03.056>

Received 3 June 2021; Received in revised form 22 January 2022; Accepted 20 March 2022

Available online 24 March 2022

0165-0327/© 2022 Elsevier B.V. All rights reserved.

the nation on April 16, with 13 major prefectures categorized as “prefectures under special precautions.” As the number of new cases decreased, the declaration was lifted in all regions on May 25, 2020.

Postnatal women are one of the most vulnerable groups in this pandemic, as most support systems or services have been eliminated at birth facilities or public health centers under infection control measures. According to a survey conducted in May 2020 by the Japanese Society of Obstetrics and Gynecology (JSOG) (Komatsu et al., 2020), 92% of the facilities discontinued birth and parenting classes, 80% prohibited partner attendance at birth, and 86% prohibited visits by family, relatives, and friends during the postpartum hospital stay. While these measures may help reduce infection risk in perinatal women, they also expose them to isolation and a higher risk of postnatal depression (Viaux et al., 2020). Moreover, pregnant women faced a significant burden of infection with SARS-CoV-2, as 66% and 80% of the facilities in Japan transferred pregnant women to limited facilities that accept infected pregnant women if they had an asymptomatic and symptomatic infection, respectively (Komatsu et al., 2020). This means that most facilities rejected the infected pregnant women.

Generally, 10–20% of mothers experience postpartum depression. A recent meta-analysis reported that postpartum depression has a global pooled prevalence of 17.7% (Hahn-Holbrook et al., 2017). According to a systematic review and meta-analysis, the COVID-19 pandemic significantly increases the risk of anxiety in pregnant and perinatal women (Hessami et al., 2020). The percentage of pregnant women who obtained scores higher than 13 on the Edinburgh Postpartum Depression Scale (EPDS) during the pandemic has been reported to be 17% in Japan (Matsushima and Horiguchi, 2020), 29.6% in China (Wu et al., 2020), 35.4% in Turkey (Durankus and Aksu, 2020), and 37% in Canada (Lebel et al., 2020). However, studies have not thoroughly investigated the prevalence of postpartum depression among postpartum women who delivered during the COVID-19 pandemic and most of them have been single-site studies (An et al., 2021; Ostacoli et al., 2020; Suzuki, 2020; Zanardo et al., 2020).

Lack of social support is a risk factor for postpartum depression (Beck, 2001). Social support is defined as “the process by which interpersonal relationships promote and protect an individual's well-being, particularly when that person is faced with stressful life circumstances” (Wills and Ainette, 2012). The COVID-19 pandemic is a stressful situation for perinatal women. Moreover, in this situation, any social support they were supposed to receive would have been diminished due to the cancellation of parenting classes or hometown delivery. A recent study during the COVID-19 pandemic reported that cancellation of planned informal support and not receiving informal childcare support were associated with depression among pregnant women (Matsushima and Horiguchi, 2020). Nonetheless, the effects of social isolation and decreased social support on postpartum depression have not been thoroughly investigated.

In Japan, it is customary for pregnant women to give birth in their hometown and stay at their parents' houses before and after delivery to receive support from them. This is called ‘Satogaeri bunben’ (‘Satogaeri’ means returning to the parents' house and ‘bunben’ means delivery, hereafter referred to as “hometown delivery”), which is a traditional support system for perinatal women in Japan (Yoshida et al., 2001). However, pregnant or postpartum women had to cancel or refrain from such travel during the pandemic. For instance, the JSOG announced on its website that as of April 21 all pregnant women should refrain from having hometown deliveries to prevent infection with SARS-CoV-2 (Japanese Society of Obstetrics and Gynecology, 2020). According to a study, 17% of the birth facilities rejected pregnant women from other prefectures (Komatsu et al., 2020). Even if a postpartum woman lives with her husband/partner, his social support may be insufficient because the time Japanese working fathers devote in household chores and childcare is only one-fifth of that of mothers, according to the 2020 Annual Report on the State of the Formation of a Gender Equal Society (Cabinet Office, 2020). Thus, the cancellation of hometown delivery

exposes mothers to a loss of social support and an increased burden of household chores and childcare, which may cause adverse mental health conditions among mothers.

According to the self-determination theory (SDT), autonomy is a fundamental psychological need (Deci and Ryan, 2000). SDT demonstrates a lack of needs satisfaction or the presence of need frustration, which may pose a risk for adverse psychological health. Several studies have suggested that autonomy determines maternal well-being or quality of parenting (Brenning and Soenens, 2017; Gauthier et al., 2010) or even depressive symptoms among mothers (Gauthier et al., 2010). During the pandemic, most perinatal women may experience a loss of autonomy due to strict infection control measures. For instance, 65% of birth facilities in Japan asked perinatal women to wear a face mask during labor and delivery, breastfeeding, and while caring for their infants at the hospital even if they were not infected (Komatsu et al., 2020). This may also impair the mental health of postpartum women.

Therefore, the aim of the current study was to investigate the effect of various social restrictions, loss of support, and loss of maternal autonomy on postpartum depression among women in Japan who delivered and raised babies during the pandemic, by comparing women who delivered between October 2019 and March 2020 (before the first state of emergency), between April and May 2020 (during the first state of emergency), and between June and October 2020 (after the first state of emergency).

2. Methods

2.1. Study design and participants

This study is a part of the “Japan COVID-19 and Society Internet Survey (JACSIS),” an ongoing longitudinal, population- and internet-based questionnaire survey (Ikeda et al., 2021; Yamada et al., 2021). Details of the study design have been described elsewhere (Miyawaki et al., 2021). The JACSIS study consisted of three surveys with the following targets: the general population ($N = 28,000$), pregnant and postpartum women ($N = 1,000$), and single mothers/fathers ($N = 1,000$). The study sample for each survey was retrieved from the pooled panels of an Internet research agency (Rakuten Insight, Inc.), which had approximately 2.2 million panelists in 2019.

In this study, we used baseline cross-sectional data from surveys of pregnant and postpartum women collected between October 15 and 25, 2020. A total of 4,373 women who had given birth after October 2019 or were expected to give birth by March 2021 were recruited from 21,896 eligible participants using simple random sampling. Due to the limited budget, data were collected until the target sample size reached 1,000 (participation rate, 22.9%). The sample comprised the following four groups: women who delivered between October 2019 and March 2020 (before the first state of emergency) ($n = 200$), women who delivered between April and May 2020 (during the first state of emergency) ($n = 200$), women who delivered between June and October 2020 (after the first state of emergency) ($n = 200$), and women who were pregnant at the time of the survey as well as expected to deliver by March 31, 2021 ($n = 400$). We included women who gave birth before the pandemic because we wanted to compare their experiences with social restrictions before and after the first state of emergency. Among the 1,000 participants, we analyzed the data of postpartum women who delivered a baby between October 2019 and October 2020 ($n = 600$).

2.2. Measurements

2.2.1. Social restriction, loss of support, and loss of autonomy during pregnancy

We asked participants if they experienced any kind of social restriction (four items), loss of social support (two items), or loss of autonomy (one item) during pregnancy (see Table 2). The response options were “yes” or “no.”

2.2.2. Social restrictions and loss of support after the delivery

We asked the participants if they experienced any kind of social restriction (six items) or loss of social support (five items) after delivery, respectively (see Table 3). The response options were “yes” and “no.”

2.2.3. Postpartum depression

The Japanese version of the EPDS has been used to measure postpartum depression (Cox et al., 1987; Okano, 1996). The EPDS consists of ten items rated on a four-point Likert scale from 0 to 3, with a total score between 0 and 30. The Japanese version of the EPDS has good reliability and validity. In this study, the Cronbach's alpha of the EPDS was 0.86. Individuals with a score of 9 or more are considered to be at a high risk of postpartum depression in Japan (Okano, 1996). In addition, we considered a cut-off of ≥ 11 and ≥ 13 , consistent with a recent systematic review and meta-analysis that reported that a cutoff value of 11 or higher maximized combined sensitivity and specificity, and a cut-off value of 13 or higher was less sensitive but more specific (Levis et al., 2020).

2.2.4. The timing of delivery

The timing of delivery was categorized into three stages: before the first state of emergency (October 2019 to March 2020), during the first state of emergency (April to May 2020), and after the first state of emergency (June to October 2020). To investigate the effect of the state of emergency, we compared the number of mothers who experienced social restrictions and the loss of social support according to the timing of delivery.

2.2.5. Confounders

Based on the reported predictors of postpartum depression (Beck, 2001; McCoy et al., 2006) and the specific COVID-19 measures, we measured potential confounders as follows: age (<29, 30–34, 35–39, or over 40), residential area (prefectures under special precautions or others), education (high school or lower, junior college/vocational school, or university or higher), annual household income during the previous year (199 or less, 200–399, 400–599, 600–799, 800–999, 1,000 or more, or unknown [ten thousand Japanese yen]), having a partner/husband (yes or no), living with a partner/husband (yes or no), living with parents/parents-in-law (yes or no), parity (primipara, multipara), unplanned/unwanted pregnancy, and depression (never, past, or current).

2.3. Statistical analyses

The following three kinds of people were considered to have inaccurate responses; those who selected “yes” to all disease lists (do you have the following diseases? [16 items]), those who selected “using some times or almost every day” for all items on alcohol product or drug use (Do you currently use alcohol products or drugs? [9 items]), and those who selected other than “D” from “A B C D E” in the question of “please select the second option from the bottom.” We excluded respondents with discrepancies or artificial/unnatural responses ($n = 42$; remaining $n = 558$).

First, we compared the prevalence of postpartum depression among each socio-demographic variable using chi-square tests. We then compared the percentages of participants who experienced social restrictions or loss of support during of after pregnancy using chi-square tests. Lastly, the prevalence ratios of postpartum depression (defined as an EPDS score of ≥ 9 , 11, and 13) among those who had experienced social restrictions, loss of support, or loss of autonomy during pregnancy or after delivery were estimated using a log-binomial regression model. This model was selected because prevalence of postpartum depression is over 10%, and the odds ratio could overestimate the prevalence ratio (Barros and Hirakata, 2003). In the analyses, we first adjusted for age, education, household income, residential area, parity, and delivery time. Subsequently, we adjusted for the prior history of depression. The

level of significance was set at $p < 0.05$ (two-tailed). Statistical analyses were conducted using SPSS 27.0 for Windows (IBM, Japan).

3. Results

3.1. Characteristics of the participants

After excluding 42 participants who provided inaccurate responses, we analyzed the data of 558 women. Approximately 46.2% were aged 30–34, 67.4% lived in prefectures under special precautions, 51.1% graduated university, 28.0% received 4.0–5.9 million yen as an annual household income, 99.3% had a partner/husband, 97.5% lived with a partner/husband, 94.3% did not live with their parents or parents-in-law, 52.7% were primipara, and 90.5% never had depression previously (Table 1).

3.2. Prevalence of postpartum depression

Regarding the overall prevalence of postpartum depression, 28.7% participants had an EPDS score ≥ 9 , 18.6% had an EPDS score ≥ 11 , and 13.1% had an EPDS score ≥ 13 (Table 1). When considering the results of EPDS ≥ 9 , participants whose educational attainment was high school or lower vs. college/university or higher (37.2% vs. 22.5%; 28.8%, $p = .031$), multipara vs. primipara (34.0% vs. 22.7%, $p = .004$), and had experienced depression currently or past vs. never (66.0%; 39.5% vs. 27.1%, $p = .020$) were more likely to have postpartum depression. There was no significant difference in the prevalence of postpartum depression according to the time of delivery.

3.3. Social restrictions, loss of support, loss of autonomy during pregnancy, and timing of delivery

During pregnancy, 63.1% of participants had experienced cancellation of birth and parenting classes, 25.1% felt that compelled to follow the doctor's instructions without communicating their preferences for delivery and breastfeeding, 17.6% were unable to speak with a friend or acquaintance about problems during pregnancy, 10.2% gave up hometown delivery, and 5% reduced the number of prenatal checkups (Table 2). Overall, 1.6% were transferred because the hospital stopped accepting deliveries or because the hospital/clinic where the hometown delivery had been scheduled refused to perform it.

Compared to postpartum women who delivered a baby before the pandemic (October 2019 to March 2020), those who delivered during the pandemic (April to May 2020 [a state of emergency] and June to October 2020) were more likely to be unable to attend birth and parenting classes during pregnancy (36.6% vs. 70.2% or 82.6%, $p < .001$) or give up hometown delivery (5.4% vs. 12.8% or 12.5%, $p = .028$).

3.4. Social restrictions or loss of support after delivery and the timing of delivery

After delivery, 73.1% of the postpartum women experienced restrictions on family members' visits during their hospital stay and the absence of their husbands during childbirth (Table 3). In addition, 24.7% were unable to get their parents or other family members to come and help them after delivery; 22.2% felt that there were few opportunities for doctors, midwives, and nurses to teach them about childcare and breastfeeding; 14.3% were unable to talk to a friend or acquaintance about breastfeeding or childcare issues; 13.4% were unable to consult with a doctor or midwife about their health; and 13.3% voluntarily refrained from receiving home visits by public health nurses or midwives.

Compared to postpartum women who delivered babies before the pandemic, those who delivered during the pandemic were more likely to experience the restriction of their family members' visits during their

Table 1
Characteristics of the participants (N = 558).

	n	%	Mean (SD)	Postnatal depression (EPDS)		
				≥9	≥11	≥13
				n (%)	n (%)	n (%)
Age			32.2 (4.1)	<i>p</i> = .428	<i>p</i> = .129	<i>p</i> = .114
< 29	140	25.1		47 (33.6)	34 (24.3)	26 (18.6)
30–34	258	46.2		73 (28.3)	43 (16.7)	27 (10.5)
35–39	134	24.0		34 (25.4)	25 (18.7)	18 (13.4)
Over 40	26	4.7		6 (23.1)	2 (7.7)	2 (7.7)
Residential area				<i>p</i> = .163	<i>p</i> = .048	<i>p</i> = .229
Prefectures under special precautions	376	67.4		115 (30.6)	79 (21.0)	54 (14.4)
Others	182	32.6		45 (24.7)	25 (13.7)	19 (10.4)
Education				<i>p</i> = .031	<i>p</i> = .069	<i>p</i> = .327
High school or lower	113	20.3		42 (37.2)	28 (24.8)	18 (15.9)
Junior college/vocational school	160	28.7		36 (22.5)	22 (13.8)	16 (10.0)
University or higher	285	51.1		82 (28.8)	54 (18.9)	39 (13.7)
Annual household income during the previous year (Ten thousand Japanese yen)				<i>p</i> = .112	<i>p</i> = .691	<i>p</i> = .463
199 or less	16	2.9		4 (25.0)	2 (12.5)	2 (12.5)
200–399	74	13.3		30 (40.5)	18 (24.3)	14 (18.9)
400–599	156	28.0		47 (30.1)	28 (17.9)	22 (14.1)
600–799	120	21.5		28 (23.3)	21 (17.5)	15 (12.5)
800–999	79	14.2		18 (22.8)	12 (15.2)	5 (6.3)
1000 or more	49	8.8		11 (22.4)	8 (16.3)	6 (12.2)
Unknown	64	11.5		22 (34.4)	15 (23.4)	9 (14.1)
Having a partner/husband				<i>p</i> = .325	<i>p</i> = 1.000	<i>p</i> = 1.000
Yes	554	99.3		158 (28.5)	104 (18.8)	73 (13.2)
No	4	0.7		2 (50.0)	0 (0.0)	0 (0.0)
Living with a partner/husband				<i>p</i> = 1.000	<i>p</i> = .485	<i>p</i> = 1.000
Yes	544	97.5		156 (28.7)	103 (18.9)	72 (13.2)
No	14	2.5		4 (28.6)	1 (7.1)	1 (7.1)
Living with parents/parents-in-law				<i>p</i> = .693	<i>p</i> = 1.000	<i>p</i> = 1.000
Yes	32	5.7		10 (31.3)	6 (18.8)	4 (12.5)
No	526	94.3		150 (28.5)	98 (18.6)	69 (13.1)
Parity				<i>p</i> = .004	<i>p</i> = .050	<i>p</i> = .033
Primipara	294	52.7		60 (22.7)	40 (15.2)	26 (9.8)
Multipara	264	47.3		100 (34.0)	64 (21.8)	47 (16.0)
Timing of delivery				<i>p</i> = .205	<i>p</i> = .238	<i>p</i> = .164

Table 1 (continued)

	n	%	Mean (SD)	Postnatal depression (EPDS)		
				≥9	≥11	≥13
				n (%)	n (%)	n (%)
Oct 2019 to Mar 2020 (7–12 months postpartum)	186	33.3		61 (32.8)	42 (22.6)	31 (16.7)
Apr to May 2020 (5–6 months postpartum)	188	33.7		46 (24.5)	31 (16.5)	19 (10.1)
Jun to Oct 2020 (0–4 months postpartum)	184	33.0		53 (28.8)	31 (16.8)	23 (12.5)
Unplanned/unwanted pregnancy				<i>p</i> = .895	<i>p</i> = .878	<i>p</i> = .600
Yes	82	14.7		136 (28.6)	88 (18.5)	61 (12.8)
No	476	85.3		24 (29.3)	16 (19.5)	12 (14.6)
Depression				<i>p</i> = .020	<i>p</i> = .001	<i>p</i> = .009
Never	505	90.5		137 (27.1)	87 (17.2)	60 (11.9)
Past	43	7.7		17 (39.5)	11 (25.6)	9 (20.9)
Current	10	1.8		6 (60.0)	6 (60.0)	4 (40.0)
Postnatal Depression (EPDS)						
Total score (0–27)			6.5 (5.2)			
EPDS ≥9						
Yes	160	28.7				
No	398	71.3				
EPDS ≥11						
Yes	104	18.6				
No	454	81.4				
EPDS ≥13						
Yes	73	13.1				
No	485	86.9				

EPDS: Edinburgh postnatal depression scale; SD: standard deviation.

hospital stay (27.4% vs. 96.3% or 95.7%, *p* < .001), lack of support from healthcare professionals or family members (10.8% vs. 33.5% or 22.3%, *p* < .001), and cancellation of planned stay at their parents' or parents-in-laws' house (4.8% vs. 15.4% or 12.0%, *p* = .003). Those who delivered their babies during the first state of emergency were more likely to voluntarily refrain from receiving home visits by public health nurses or midwives after delivery than those who delivered babies before the pandemic or after the first state of emergency was lifted (20.7% vs. 11.3% or 7.6%, *p* < .001). On the other hand, mothers who labored before the pandemic were more likely to experience cancellation of infant health checkups or vaccinations despite their request (8.6% vs. 3.7% or 3.3%, *p* = .037).

3.5. Social restrictions, loss of support, and loss of autonomy during pregnancy and postpartum depression

After adjusting for age, education, household income, residential area, parity, the timing of delivery, a prior history of depression, loss of autonomy about delivery or breastfeeding and loss of opportunity to talk with friends about concerns during pregnancy were associated with postnatal depression (EPDS ≥11 and 13) (Table 4). Additionally, when an outcome was defined as an EPDS score ≥9, reducing the number of prenatal checkups and giving up hometown delivery were found to be significantly associated with postnatal depression.

Table 2
Social restrictions and loss of support during pregnancy and the timing of delivery.

	All		Oct 2019 to Mar 2020		Apr to May 2020		Jun to Oct 2020		p
	n	%	n	%	n	%	n	%	
Social restrictions									
Reduced the number of prenatal checkups	0.083								
Yes	28	5.0	4	2.2	13	6.9	11	6.0	
No	530	95.0	182	97.8	175	93.1	173	94.0	
Cancellation of birth and parenting classes	<0.001								
Yes	352	63.1	68	36.6	132	70.2	152	82.6	
No	206	36.9	118	63.4	56	29.8	32	17.4	
Having been transferred because the hospital/clinic stopped accepting delivery	0.348								
Yes	9	1.6	2	1.1	2	1.1	5	2.7	
No	549	98.4	184	98.9	186	98.9	179	97.3	
The hospital/clinic where the hometown delivery had been scheduled refused delivery	0.088								
Yes	9	1.6	2	1.1	1	0.5	6	3.3	
No	549	98.4	184	98.9	187	99.5	178	96.7	
Loss of social support									
Gave up hometown delivery	0.028								
Yes	57	10.2	10	5.4	24	12.8	23	12.5	
No	501	89.8	176	94.6	164	87.2	161	87.5	
Unable to talk with friends about concerns during pregnancy	0.100								
Yes	98	17.6	24	12.9	35	18.6	39	21.2	
No	460	82.4	162	87.1	153	81.38	145	78.8	
Loss of autonomy									
Compelled to follow the doctor's instructions without communicating their preferences for delivery and breastfeeding	0.489								
Yes	140	25.1	41	22.0	51	27.1	48	26.1	
No	418	74.9	145	78.0	137	72.9	136	73.9	

3.6. Social restrictions or lack of support after delivery and postnatal depression

Among social restriction variables, loss of opportunities to receive home visits by healthcare professionals and loss of opportunities to receive infant checkups and vaccinations were significantly associated with all definitions of postnatal depression (EPDS ≥ 9 , 11, and 13), after adjusting for age, education, household income, residential area, parity, the timing of delivery, and a prior history of depression (Table 5). The absence of a husband at childbirth was significantly associated with postnatal depression only in the EPDS ≥ 9 model. In contrast, restrictions on family visits during hospital stay were significantly associated with postnatal depression only in the EPDS ≥ 13 model.

All of the social support variables, including loss of parents' or family members' support, cancellation of staying at parents' or parents-in-law's house, few opportunities to learn about childcare and breastfeeding from healthcare professionals during the hospital stay, loss of opportunities to consult with healthcare professionals about their health, and loss of opportunities to talk with a friend/acquaintance about breastfeeding or childcare issues, were significantly associated with all definitions of postnatal depression.

4. Discussion

This study investigated the effect of social restrictions or lack of social support on postpartum depression among women who delivered and raised babies during the pandemic. Various social restrictions, including the loss of opportunities to receive infant health checkups and

vaccinations, loss of support from healthcare professionals, families, or friends, and loss of autonomy regarding delivery or breastfeeding, were significantly associated with postnatal depression after adjusting for potential confounders. The results indicate that both formal and informal support should not be limited to preventing postpartum depression during the COVID-19 pandemic.

When using a cutoff value of 9, the prevalence of postpartum depression was 28.7% in the current study, which is much higher than the prevalence of 14.4% among postpartum women during the pandemic (Suzuki, 2020) or a recent meta-analysis for Japanese women (14.3%) (Tokumitsu et al., 2020). On the other hand, when using higher cutoff points (≥ 11 or 13), the prevalence of postpartum depression in the current study (18.6% or 13.1%) was much lower than that in other studies in countries with high death tolls due to COVID-19: 28.6% or 44.2% (both EPDS ≥ 13) in Italy (Ostacoli et al., 2020; Zanardo et al., 2020); 56.9% (EPDS ≥ 10) in China (An et al., 2021). However, the prevalence was similar to other studies with the same definition (EPDS ≥ 13): 17% among Japanese pregnant women during the pandemic (Matsushima and Horiguchi, 2020), or 13–17% in meta-analyses before the pandemic (Hahn-Holbrook et al., 2017; O'Hara and Swain, 1996). This indicates that mothers with a severe level of postpartum depression are few in Japan compared to other countries with high death tolls due to COVID-19 but those with a mild level of postpartum depression are prevalent, even where one of the smallest death tolls was reported due to COVID-19 (8,929 as of March 25, 2021, in Japan).

Surprisingly, the highest prevalence of postpartum depression in the current study was found among postpartum women who delivered babies between October 2019 and March 2020, which was 7–12 months postpartum, although the difference was not significant. As reported by a recent meta-analysis (Tokumitsu et al., 2020), the prevalence of depression usually decreases during the postpartum period. For example, the period prevalence of postpartum depression (EPDS ≥ 9) was 15.1% within the first month, 11.6% at 1–3 months, 11.5% at 3–6 months, and 11.5% at 6–12 months after birth (Tokumitsu et al., 2020). Mothers who delivered babies from October 2019 to March 2020 had to raise their baby during a state of emergency (April–May 2020), and they were hesitant to even go outside for a walk because of the high social pressure to stay at home. The elementary schools or nursery schools were closed and their husbands started to work from home; the mothers had to take care of their babies and husbands, which increased mothers' demands and raised their anxiety about raising their children (Takaku and Yokoyama, 2021). This can influence the high prevalence of postpartum depression among who were 7–12 months postpartum in the current study. As the COVID-19 pandemic may have changed the pre-pandemic trend of postpartum depression, healthcare professionals should provide long-term care for postpartum mothers.

Postpartum women who delivered babies during the pandemic were more likely to experience social restrictions and loss of support during pregnancy and after delivery than those who delivered babies before the pandemic. Under the birth facilities' COVID-19 preventive measures (Japanese Society of Obstetrics and Gynecology, 2020), they lost opportunities to attend birth and parenting classes, consult with healthcare professionals, or accept family visits during the hospital stay, and had to cancel hometown delivery or a planned stay at their parents' or parents-in-laws' house. This is consistent with a study that reported that many pregnant women experienced social restrictions during the pandemic (Matsushima and Horiguchi, 2020). These social restrictions would cause a loss of social support from healthcare professionals, families, and friends. For example, one-third of the women in this study answered that they they could not get support from their parents or other family members. Although surveys of social restrictions have been conducted for birth facilities (Komatsu et al., 2020) and pregnant women (Matsushima and Horiguchi, 2020), no study has asked postpartum women what kind of social restrictions, loss of support, or loss of autonomy they experienced during the pandemic. The results of this study expand the scientific evidence and indicate that the COVID-19 preventive measures

Table 3
Social restrictions and loss of support after childbirth and the timing of delivery.

	All		Oct 2019 to Mar 2020		Apr to May 2020		Jun to Oct 2020		p
	n	%	n	%	n	%	n	%	
Social restrictions									
No husband/partner attendance in the delivery room despite their wish	0.873								
Yes	23	4.8	7	4.1	9	5.2	7	5.1	
No	456	95.2	163	95.9	163	94.8	130	94.9	
Restrictions of family visits during hospital stay	<0.001								
Yes	408	73.1	51	27.4	181	96.3	176	95.7	
No	150	26.9	135	72.6	7	3.7	8	4.3	
Not given home visits services by public health nurses or midwives despite their request	0.887								
Yes	24	4.3	7	3.8	9	4.8	8	4.3	
No	534	95.7	179	96.2	179	95.2	176	95.7	
Voluntarily refrained from receiving home visits by public health nurses or midwives	<0.001								
Yes	74	13.3	21	11.3	39	20.7	14	7.6	
No	484	86.7	165	88.7	149	79.3	170	92.4	
Not given infant health checkups and vaccinations despite their request	0.037								
Yes	29	5.2	16	8.6	7	3.7	6	3.3	
No	529	94.8	170	91.4	181	96.3	178	96.7	
Voluntarily refrained from having infant checkups and vaccinations	0.459								
Yes	27	4.8	11	5.9	10	5.3	6	3.3	
No	531	95.2	175	94.1	178	94.7	178	96.7	
Loss of social support									
Cancellation of parents or other family members' visits to support	0.000								
Yes	138	24.7	27	14.5	62	33.0	49	26.6	
No	420	75.3	159	85.5	126	67.0	135	73.4	
Cancellation of planned stay at their parents'/parents-in-laws' house	0.003								
Yes	60	10.8	9	4.8	29	15.4	22	12.0	
No	498	89.2	177	95.2	159	84.6	162	88.0	
Few opportunities of being taught about childcare and breastfeeding by doctors, midwives, and nurses at hospital ward	<0.001								
Yes	124	22.2	20	10.8	63	33.5	41	22.3	
No	434	77.8	166	89.2	125	66.5	143	77.7	
Unable to consult with doctors or midwives about their health despite their needs	0.618								
Yes	75	13.4	23	12.4	29	15.4	23	12.5	
No	483	86.6	163	87.6	159	84.6	161	87.5	
Unable to talk with friends about breastfeeding or childcare issues despite their needs	0.698								
Yes	80	14.3	24	12.9	30	16.0	26	14.1	
No	478	85.7	162	87.1	158	84.0	158	85.9	

expose mothers to loss of social support.

Various COVID-19 related social restrictions and a lack of social support were found to be associated with postnatal depression in our study. This is consistent with a previous study on pregnant women that reported the cancellation of planned informal support and not receiving informal childcare support associated with prenatal depression during the COVID-19 pandemic (Matsushima and Horiguchi, 2020), as well as a study reporting that a lack of social support is a risk factor for postpartum depression (Beck, 2001; Collins et al., 1993). In addition to this evidence, the current study revealed three specific variables associated with postpartum depression during the pandemic, 1) loss of support from healthcare professionals, 2) loss of support from family or friends, and 3) loss of maternal autonomy in delivery and breastfeeding.

Social support from healthcare professionals mainly consists of informational support (e.g., information that might be used to deal with stress) (Cohen et al., 1985; Robertson et al., 2004) because they provide information on how to breathe during delivery or how to raise a child at prenatal checkups, hospital stay, and infant checkups. In this study, 20–30% of mothers who gave birth during the pandemic experienced fewer opportunities to be taught about childcare and breastfeeding by doctors, midwives, and nurses during their hospital stay, and they were twice as likely to have postpartum depression than those who did not. This indicates that the lack of informational support could be associated with postpartum depression, which is consistent with a report indicating that receiving informational support protect against postpartum depression (Heh and Fu, 2003). Although face-to-face communication is difficult during the pandemic, online consulting provided by healthcare professionals would be beneficial for postpartum women since most mothers prefer one-on-one support when postpartum depression is recognized (Letourneau et al., 2007).

Support from family or friends can include emotional support (e.g., expression of caring), tangible or instrumental support (e.g., direct material aid including finance), or belonging support (e.g., having others to engage in social activities) (Cohen et al., 1985; Robertson et al., 2004). In this study, mothers who experienced a loss of support from their parents or other family members or a loss of opportunities to consult with friends about childcare were twice as likely to have postpartum depression. As previously reported (Beck, 2001; O'Hara and Swain, 1996), emotional and instrumental support are vital in preventing postpartum depression. This study indicates that informal support can prevent postnatal depression, in addition to formal support from healthcare professionals.

Approximately 25% of the mothers experienced a loss of maternal autonomy in delivery or breastfeeding during the COVID-19 pandemic. According to a longitudinal study (Gauthier et al., 2010), high levels of parental autonomous motivation (autonomy) predict lower levels of depressive symptoms among mothers. According to SDT (Deci and Ryan, 2000), a lack of needs satisfaction or the presence of need frustration may pose a risk for adverse psychological health, as several studies have suggested that it determines maternal well-being or quality of parenting (Brenning and Soenens, 2017; Gauthier et al., 2010). Moreover, a study reported a sense of control predicts depressive and anxious symptoms in mothers (Keeton et al., 2008). Thus, the findings of our study showing the association between a loss of autonomy in delivery or breastfeeding and postpartum depression align with these studies.

Contrary to our expectations, giving up hometown delivery was not significantly associated with postpartum depression when defined as EPDS ≥ 11 or 13, although the association was significant when using the definition of EPDS ≥ 9 . This indicates that the association between hometown delivery and postpartum depression is weak. Although a non-significant association was against our expectation, this is consistent with a cross-cultural study that reported that hometown delivery itself did not lower the incidence of postnatal depression (Yoshida et al., 2001). When a woman delivered her baby in her hometown, she usually stayed at her parents' home for several months. This helped her to receive support from her parents, but at the same time, she lost support

Table 4
Social restrictions and lack of support during pregnancy and postpartum depression: log-binominal regression analysis.

	Number of cases (%)			Prevalence ratios of postnatal depression ‡		
	EPDS ≥9	EPDS ≥11	EPDS ≥13	EPDS ≥9	EPDS ≥11	EPDS ≥13
Social restrictions						
Reduced the number of prenatal checkups						
Yes	12 (42.9)	8 (28.6)	6 (21.4)	1.59 (1.00 to 2.51)	1.72 (0.93 to 3.18)	1.79 (0.84 to 3.81)
No	148 (27.9)	109 (20.6)	75 (14.2)	1.00	1.00	1.00
Cancellation of birth and parenting classes						
Yes	92 (26.1)	67 (19.0)	44 (12.5)	0.86 (0.62 to 1.19)	0.88 (0.59 to 1.31)	0.70 (0.44 to 1.11)
No	68 (33.0)	50 (24.3)	37 (18.0)	1.00	1.00	1.00
Loss of social support						
Gave up hometown delivery						
Yes	24 (42.1)	19 (33.3)	11 (19.3)	1.48 (1.06 to 2.06)	1.48 (0.92 to 2.38)	1.50 (0.84 to 2.66)
No	136 (27.1)	98 (19.6)	70 (14.0)	1.00	1.00	1.00
Unable to talk with friends about concerns during pregnancy						
Yes	46 (46.9)	41 (41.8)	30 (30.6)	1.86 (1.42 to 2.43)	2.73 (1.96 to 3.80)	3.39 (2.21 to 5.21)
No	114 (24.8)	76 (16.5)	51 (11.1)	1.00	1.00	1.00
Loss of autonomy						
Compelled to follow the doctor's instructions without communicating their preferences for delivery and breastfeeding						
Yes	54 (38.6)	42 (30.0)	29 (20.7)	1.50 (1.15 to 1.95)	1.61 (1.13 to 2.28)	1.69 (1.09 to 2.63)
No	106 (25.4)	75 (17.9)	52 (12.4)	1.00	1.00	1.00

‡ Adjusting for age, education, household income, residential area, parity, delivery time, and a prior history of depression.

from her partner because they had to live separately. Yoshida noted out that this is a disadvantage of hometown delivery (Yoshida et al., 2001), implying that hometown delivery may not always prevent postpartum depression.

While the cancellation of birth and parenting classes was not associated with postpartum depression, restrictions on family visits during the hospital stay were negatively associated with postpartum depression. This might be due to the matching hypothesis of social support, which states that social support buffers stress only when that support matches the stressful event or the receiver's need (Cohen and Wills, 1985). Whether support responds to an individual's needs or is perceived as supportive is more important than increasing the amount of support received (Wills and Shinar, 2000); whether attending birth and parenting classes would reduce mothers' stress and prevent postpartum depression depends on an individual's case. In other words, if birth and parenting classes match mothers' needs, it may be beneficial for their mental health. In contrast, mothers who experienced restrictions on family visits during their hospital stay were less likely to have postpartum depression. This might be because mothers were able to rest during the hospital stay, owing to the lack of visitors. However, this association was only significant in the EPDS ≥13 model; therefore, our results should be generalized with caution.

5. Limitations

The current study had several limitations. First, we could not determine a causal relationship because of the cross-sectional study design. Although participants' experiences during pregnancy or the hospital stay cannot be changed because this study was limited to postpartum women, the variables of infant checkups and vaccinations or social support from healthcare professionals, families, and friends may

Table 5
Social restriction and lack of support after childbirth and postpartum depression: log-binominal regression analysis.

	Number of cases (%)			Prevalence ratios of postnatal depression ‡		
	EPDS ≥9	EPDS ≥11	EPDS ≥13	EPDS ≥9	EPDS ≥11	EPDS ≥13
Social restrictions						
No husband/partner attendance in the delivery room despite their wish						
Yes	11 (47.8)	8 (34.8)	5 (21.7)	1.75 (1.11 to 2.74)	1.53 (0.84 to 2.79)	1.19 (0.50 to 2.85)
No	125 (27.4)	82 (18.0)	58 (12.7)	1.00	1.00	1.00
Restrictions on family visits during hospital stay						
Yes	110 (27.0)	78 (19.1)	50 (12.3)	0.81 (0.61 to 1.07)	0.79 (0.47 to 1.35)	0.50 (0.26 to 0.98)
No	50 (33.3)	39 (26.0)	31 (20.7)	1.00	1.00	1.00
Not given home visits services by public health nurses or midwives despite their request						
Yes	11 (45.8)	11 (45.8)	8 (33.3)	1.64 (1.04 to 2.59)	2.36 (1.49 to 3.74)	2.49 (1.39 to 4.47)
No	149 (27.9)	106 (19.9)	73 (13.7)	1.00	1.00	1.00
Voluntarily refrained from receiving home visits by public health nurses or midwives						
Yes	23 (31.1)	19 (25.7)	14 (18.9)	1.10 (0.76 to 1.59)	1.43 (0.93 to 2.20)	1.42 (0.82 to 2.45)
No	137 (28.3)	98 (20.2)	67 (13.8)	1.00	1.00	1.00
Not given infant health checkups and vaccinations despite their request						
Yes	8 (66.7)	7 (58.3)	6 (50.0)	2.03 (1.40 to 2.94)	2.84 (1.80 to 4.48)	4.69 (2.89 to 7.61)
No	152 (27.8)	110 (20.1)	75 (13.7)	1.00	1.00	1.00
Voluntarily refrained from having infant checkups and vaccinations						
Yes	7 (58.3)	7 (58.3)	6 (50.0)	2.20 (1.57 to 3.08)	3.76 (2.57 to 5.48)	4.61 (2.86 to 7.43)
No	153 (28.0)	110 (20.1)	75 (13.7)	1.00	1.00	1.00
Loss of social support						
Cancellation of parents or other family members' visits to support						
Yes	53 (38.4)	42 (30.4)	30 (21.7)	1.51 (1.15 to 1.97)	1.95 (1.38 to 2.75)	2.12 (1.39 to 3.23)
No	107 (25.5)	75 (17.9)	51 (12.1)	1.00	1.00	1.00
Cancellation of planned stay at their parents'/parents-in-laws' house						
Yes	25 (41.7)	23 (38.3)	15 (25.0)	1.54 (1.10 to 2.14)	2.21 (1.50 to 3.24)	2.17 (1.29 to 3.66)
No	135 (27.1)	94 (18.9)	66 (13.3)	1.00	1.00	1.00
Few opportunities of being taught about childcare and breastfeeding by doctors, midwives, and nurses at hospital ward						
Yes	45 (36.3)	33 (26.6)	27 (21.8)	1.37 (1.03 to 1.81)	1.52 (1.04 to 2.21)	1.96 (1.25 to 3.07)
No	115 (26.5)	84 (19.4)	54 (12.4)	1.00	1.00	1.00
Unable to consult with doctors or midwives about their health despite their needs						
Yes	34 (45.3)	29 (38.7)	20 (26.7)	1.74 (1.30 to 2.32)	1.98 (1.34 to 2.93)	2.28 (1.37 to 3.81)
No	126 (26.1)	88 (18.2)	61 (12.6)	1.00	1.00	1.00
Unable to talk with friends about breastfeeding or childcare issues despite their needs						
Yes	39 (48.8)	35 (43.8)	22 (27.5)	1.93 (1.47 to 2.53)	2.50 (1.77 to 3.52)	2.48 (1.57 to 3.93)
No	121 (25.3)	82 (17.2)	59 (12.3)	1.00	1.00	1.00

‡ Adjusting for age, education, household income, residential area, parity, delivery time, and a prior history of depression.

be affected by psychological health status. We plan a follow-up survey to address this. Second, postpartum depression was defined on a scale that was not diagnosed by a doctor. Although EPDS is commonly used in epidemiological studies, its prevalence and association with other variables might differ from those of clinically diagnosed postpartum depression. Finally, there might be a sampling bias due to the nature of

the online survey. In addition, since the participants had to answer many questions, some postpartum women with severe depression were unable to respond, which may have underestimated the prevalence of postpartum depression. A longitudinal study with large sample size is needed to clarify the association between social restrictions and postpartum depression during the COVID-19 pandemic.

6. Conclusions

At least 13% of women who delivered and raised a baby during the COVID-19 pandemic had postpartum depressive symptoms above the cut-off (EPDS ≥ 13). COVID-19 related social restrictions and loss of social support from healthcare professionals, families, and friends were significantly associated with postpartum depression. In addition, loss of maternal autonomy in delivery and breastfeeding was associated with the risk of postpartum depression. The results indicate that both formal and informal support should not be limited to preventing postpartum depression during a pandemic.

CRedit authorship contribution statement

K.T., S.O., and T.T. designed the study, wrote the protocol, and collected the data. K.T. undertook the statistical analysis and wrote the first draft of the manuscript. All authors significantly contributed to the interpretation of the data and revising the manuscript. All authors have approved the final manuscript.

Funding

The JACSIS study was supported by the Japan Society for the Promotion of Science (JSPS) KAKENHI Grants [grant number: 17H03589; 18H03062; 18H03107; 19K10446; 19K10671], the JSPS Grant-in-Aid for Early-Career Scientists [grant number: 19K19439], Research Support Program to Apply the Wisdom of the University to tackle COVID-19 Related Emergency Problems, University of Tsukuba, and Health Labour Sciences Research Grant [grant number: 19FA1005; 19FG2001]. The findings and conclusions of this article are the sole responsibility of the authors and do not represent the official views of the research funders. The authors report no conflicts of interest.

Ethical issues

The study protocol was reviewed and approved by the Research Ethics Committee of the Osaka International Cancer Institute (approved on June 19, 2020; approval number 20084). All participants provided web-based informed consent before responding to the online questionnaire. A credit point known as “Epoints,” which could be used for internet shopping and cash conversion, was provided to the participants as an incentive.

Data availability

The data used in this study are not available in a public repository because they contain personally identifiable or potentially sensitive patient information. Based on the regulations for ethical guidelines in Japan, the Research Ethics Committee of the Osaka International Cancer Institute has imposed restrictions on the dissemination of the data collected in this study. All data inquiries should be addressed to the person responsible for data management, Dr. Takahiro Tabuchi at the following e-mail address: tabuchitak@gmail.com.

Declaration of competing interest

The authors report no conflicts of interest.

Acknowledgements

We thank all researchers who participated and provided supports to the JACSIS study. The first author (K.T.) also thanks to her second son, who was born healthy during the COVID-19 pandemic (December 2020).

References

- An, R., Chen, X., Wu, Y., Liu, J., Deng, C., Liu, Y., Guo, H., 2021. A survey of postpartum depression and health care needs among chinese postpartum women during the pandemic of COVID-19. *Arch. Psychiatr. Nurs.* 35, 172–177.
- Barros, A.J., Hirakata, V.N., 2003. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med. Res. Methodol.* 3, 1–13.
- Beck, C.T., 2001. Predictors of postpartum depression: an update. *Nurs. Res.* 50, 275–285.
- Brenning, K., Soenens, B., 2017. A self-determination theory perspective on postpartum depressive symptoms and early parenting behaviors. *J. Clin. Psychol.* 73, 1729–1743.
- Cabinet Office, 2020. The balance between housework, childbearing, nursing, and work. In: 2020 Annual Report on the State of the Formation of a Gender Equal Society. Cabinet Office, Tokyo, pp. 3–87.
- Cohen, S., Wills, T.A., 1985. Stress, social support, and the buffering hypothesis. *Psychol. Bull.* 98, 310–357.
- Cohen, S., Mermelstein, R., Kamarck, T., Hoberman, H.M., 1985. In: *Measuring the Functional Components of Social Support, Social Support: Theory, Research and Applications*. Springer, pp. 73–94.
- Collins, N.L., Dunkel-Schetter, C., Lobel, M., Scrimshaw, S.C., 1993. Social support in pregnancy: psychosocial correlates of birth outcomes and postpartum depression. *J. Pers. Soc. Psychol.* 65, 1243–1258.
- Cox, J.L., Holden, J.M., Sagovsky, R., 1987. Detection of postnatal depression: development of the 10-item Edinburgh postnatal depression scale. *Br. J. Psychiatry* 150, 782–786.
- Deci, E.L., Ryan, R.M., 2000. The “what” and “why” of goal pursuits: human needs and the self-determination of behavior. *Psychol. Inq.* 11, 227–268.
- Durankus, F., Aksu, E., 2020. Effects of the COVID-19 pandemic on anxiety and depressive symptoms in pregnant women: a preliminary study. *J. Matern. Fetal Neonatal Med.* 35, 205–211.
- Gauthier, L., Guay, F., Senécal, C., Pierce, T., 2010. Women’s depressive symptoms during the transition to motherhood: the role of competence, relatedness, and autonomy. *J. Health Psychol.* 15, 1145–1156.
- Hahn-Holbrook, J., Cornwell-Hinrichs, T., Anaya, I., 2017. Economic and health predictors of National Postpartum Depression Prevalence: a systematic review, meta-analysis, and meta-regression of 291 studies from 56 countries. *Front. Psychiatry* 8, 248.
- Heh, S.S., Fu, Y.Y., 2003. Effectiveness of informational support in reducing the severity of postnatal depression in Taiwan. *J. Adv. Nurs.* 42, 30–36.
- Hessami, K., Romanelli, C., Chiurazzi, M., Cozzolino, M., 2020. COVID-19 pandemic and maternal mental health: a systematic review and meta-analysis. *J. Matern. Fetal Neonatal Med.* 1–8.
- Ikeda, T., Igarashi, A., Odani, S., Murakami, M., Tabuchi, T., 2021. Health-related quality of life during COVID-19 pandemic: assessing impacts of job loss and financial support programs in Japan. *Appl. Res. Qual. Life* 1–17.
- Japanese Society of Obstetrics and Gynecology, 2020. To Pregnant Women: About Hometown Delivery [in Japanese]. Japanese Society of Obstetrics and Gynecology, Tokyo. http://www.jsog.or.jp/modules/jsogpolicy/index.php?content_id=11.
- Keeton, C.P., Perry-Jenkins, M., Sayer, A.G., 2008. Sense of control predicts depressive and anxious symptoms across the transition to parenthood. *J. Fam. Psychol.* 22, 212–221.
- Komatsu, H., Banno, K., Yanaihara, N., Kimura, T., Board Members of Japan Society of O., Gynecology, 2020. Prevention and practice during the COVID-19 emergency declaration period in Japanese obstetrical/gynecological facilities. *J. Obstet. Gynaecol. Res.* 46, 2237–2241.
- Lebel, C., MacKinnon, A., Bagshawe, M., Tomfohr-Madsen, L., Giesbrecht, G., 2020. Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. *J. Affect. Disord.* 277, 5–13.
- Letourneau, N., Duffett-Leger, L., Stewart, M., Hegadoren, K., Dennis, C.L., Rinaldi, C.M., Stoppard, J., 2007. Canadian mothers’ perceived support needs during postpartum depression. *J. Obstet. Gynecol. Neonatal. Nurs.* 36, 441–449.
- Levis, B., Negeri, Z., Sun, Y., Benedetti, A., Thombs, B.D., DEPRESSION Screening Data (DEPRESSD) EPDS Group, 2020. Accuracy of the Edinburgh Postnatal Depression Scale (EPDS) for screening to detect major depression among pregnant and postpartum women: systematic review and meta-analysis of individual participant data. *BMJ* 371, m4022.
- Looi, M.K., 2020. Covid-19: Japan prepares to extend state of emergency nationwide as “untraceable” cases soar. *BMJ* 369, m1543.
- Matsushima, M., Horiguchi, H., 2020. The COVID-19 pandemic and mental well-being of pregnant women in Japan: need for economic and social policy interventions. *Disaster Med. Public Health Prep.* 1–6.
- McCoy, S.J.B., Beal, J.M., Shipman, S.B.M., Payton, M.E., Watson, G.H., 2006. Risk factors for postpartum depression: a retrospective investigation at 4-weeks postnatal and a review of the literature. *J. Osteopath. Med.* 106, 193–198.

- Miyawaki, A., Tabuchi, T., Tomata, Y., Tsugawa, Y., 2021. Association between participation in the government subsidy programme for domestic travel and symptoms indicative of COVID-19 infection in Japan: cross-sectional study. *BMJ Open* 11, e049069.
- O'Hara, M.W., Swain, A.M., 1996. Rates and risk of postpartum depression—a meta-analysis. *Int. Rev. Psychiatry* 8, 37–54.
- Okano, T., 1996. Validation and reliability of a Japanese version of the EPDS. *Arch. Psychiatr. Diagn. Clin. Eval.* 7, 525–533.
- Ostacoli, L., Cosma, S., Bevilacqua, F., Berchiolla, P., Bovetti, M., Carosso, A.R., Malandrone, F., Carletto, S., Benedetto, C., 2020. Psychosocial factors associated with postpartum psychological distress during the Covid-19 pandemic: a cross-sectional study. *BMC Pregnancy Childbirth* 20, 703.
- Robertson, E., Grace, S., Wallington, T., Stewart, D.E., 2004. Antenatal risk factors for postpartum depression: a synthesis of recent literature. *Gen. Hosp. Psychiatry* 26, 289–295.
- Suzuki, S., 2020. Psychological status of postpartum women under the COVID-19 pandemic in Japan. *J. Matern. Fetal Neonatal Med.* 1–3.
- Takaku, R., Yokoyama, I., 2021. What the COVID-19 school closure left in its wake: evidence from a regression discontinuity analysis in Japan. *J. Public Econ.* 195, 104364.
- Tokumitsu, K., Sugawara, N., Maruo, K., Suzuki, T., Shimoda, K., Yasui-Furukori, N., 2020. Prevalence of perinatal depression among Japanese women: a meta-analysis. *Ann. General Psychiatry* 19, 41.
- Viaux, S., Maurice, P., Cohen, D., Jouannic, J.M., 2020. Giving birth under lockdown during the COVID-19 epidemic. *J. Gynecol. Obstet. Hum. Reprod.* 49, 101785.
- Wills, T.A., Ainette, M.C., 2012. Social networks and social support. In: Baum, A., Revenson, T.A., Singer, J. (Eds.), *Handbook of Health Psychology*. Psychology Press, pp. 465–492.
- Wills, T.A., Shinar, O., 2000. Measuring perceived and received social support. In: *Social Support Measurement and Intervention: A Guide for Health and Social Scientists*. Oxford University Press, New York, NY, US, pp. 86–135.
- Wu, Y., Zhang, C., Liu, H., Duan, C., Li, C., Fan, J., Li, H., Chen, L., Xu, H., Li, X., Guo, Y., Wang, Y., Li, X., Li, J., Zhang, T., You, Y., Li, H., Yang, S., Tao, X., Xu, Y., Lao, H., Wen, M., Zhou, Y., Wang, J., Chen, Y., Meng, D., Zhai, J., Ye, Y., Zhong, Q., Yang, X., Zhang, D., Zhang, J., Wu, X., Chen, W., Dennis, C.L., Huang, H.F., 2020. Perinatal depressive and anxiety symptoms of pregnant women during the coronavirus disease 2019 outbreak in China. *Am. J. Obstet. Gynecol.* 223 (240), e1–9.
- Yamada, K., Wakaizumi, K., Kubota, Y., Murayama, H., Tabuchi, T., 2021. Loneliness, social isolation, and pain following the COVID-19 outbreak: data from a nationwide internet survey in Japan. *Sci. Rep.* 11, 18643.
- Yoshida, K., Yamashita, H., Ueda, M., Tashiro, N., 2001. Postnatal depression in Japanese mothers and the reconsideration of 'Satogaeri bunben'. *Pediatr. Int.* 43, 189–193.
- Zanardo, V., Manghina, V., Giliberti, L., Vettore, M., Severino, L., Straface, G., 2020. Psychological impact of COVID-19 quarantine measures in northeastern Italy on mothers in the immediate postpartum period. *Int. J. Gynaecol. Obstet.* 150, 184–188.