Influence of the COVID-19 pandemic on breastfeeding support for healthy mothers and the association between compliance with WHO recommendations for breastfeeding support and exclusive breastfeeding in Japan

Keiko Nanishi¹, Sumiyo Okawa², Hiroko Hongo³, Akira Shibanuma¹, Sarah K. Abe⁴ and Takahiro Tabuchi⁵

¹ Office of International Academic Affairs, Graduate School of Medicine, The University of Tokyo, Bunkyo-ku, Tokyo, Japan
² Institute for Global Health Policy Research, Bureau of International Health Cooperation, National Center for Global Health and Medicine, Shinjuku-ku, Tokyo, Japan
³ Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Bunkyo-ku, Tokyo, Japan
⁴ Division of Prevention, National Cancer Center, Institute for Cancer Control, Chuo-ku, Tokyo, Japan
⁵ Department of Cancer Epidemiology, Cancer Control Center, Osaka International Cancer Institute, Osaka City, Osaka, Japan

ABSTRACT

Background. Professional breastfeeding support contributes to maternal and child health. However, the influence of the current coronavirus disease 2019 (COVID-19) pandemic on breastfeeding support has not been carefully examined. Therefore, we assessed maternal breastfeeding intention and professional breastfeeding support before and during the pandemic. We further examined the association of compliance with World Health Organization (WHO) recommendations for professional breastfeeding support with exclusive breastfeeding during the pandemic.

Methods. This cross-sectional, internet-based, questionnaire study analyzed data from 484 healthy women with live singleton births between 15 October 2019 and 25 October 2020 in Japan. A delivery before 5 March 2020 was classified as a before-pandemic delivery (n = 135), and a delivery after 6 March 2020 was a during-pandemic delivery (n = 349). Among the ten breastfeeding support steps recommended by the WHO, we assessed the five steps that are measurable by maternal self-report and would likely exhibit variability. Receipt of a free formula sample or invitation to a free sample campaign at the time of survey was also asked. Infant feeding status at the time of the survey was measured among women with infants younger than 5 months, which was a subgroup of mothers who delivered during the pandemic. Mothers were asked what was given to infants during the 24 h before the survey and when nothing other than breast milk was given, the status was classified as exclusive breastfeeding.

Results. While 82.2% of women with a delivery before the pandemic intended to breastfeeding, the rate was 75.6% during the pandemic (p = 0.120). The average number of breastfeeding support steps received was 3.24 before the pandemic but it was 3.01 during the pandemic (p = 0.069). In particular, rooming-in was less frequent (39.3%...
before vs. 27.8% during the pandemic, \( p = 0.014 \). Among mothers with infants younger than 5 months who had a delivery during the pandemic \((n = 189)\), only 37.0% \((n = 70)\) reported exclusively breastfeeding during the 24 h before completing the survey. Multiple logistic regression analysis indicated that receiving support for all five steps was positively associated with exclusive breastfeeding during the 24 h before the survey (adjusted odds ratio 4.51; 95% CI [1.50–13.61]). Receipt of a free formula sample or invitation to a free sample campaign was negatively associated with exclusive breastfeeding (adjusted odds ratio 0.43; 95% CI [0.19–0.98]). Other factors related to non-exclusive breastfeeding were older maternal age, lower education level, primiparity, and no breastfeeding intention.

**Conclusions.** The pandemic weakened breastfeeding support for healthy women in Japan; however, support practice that adhered to WHO recommendations appeared to be effective during the pandemic.

**Subjects** Gynecology and Obstetrics, Nutrition, Pediatrics, COVID-19, Healthcare Services  
**Keywords** COVID-19, Professional breastfeeding support, Ten steps to successful breastfeeding, Exclusive breastfeeding, Japan

**INTRODUCTION**

The COVID-19 pandemic has changed people’s lives. A key strategy in controlling the pandemic is maintaining physical distance from other people. Some countries implemented urban lockdowns, and many restricted social activities in order to reduce contact between people. In Japan, although no city lockdown has been ordered, during periods of high COVID-19 transmission the national and local governments have requested people to stay home, work remotely, and avoid inter-prefectural travel and urged restrictions on entry to shopping malls and other places that encourage people to leave their homes. Although attention is understandably focused on patients with severe COVID-19, uninfected persons are affected by isolation from social networks that help them choose healthy behaviors and maintain health and well-being. Pregnant women and mothers with infants require particular forms of assistance from professionals, friends, and family, as they must maintain their health and that of their infants, adopt child care skills, initiate and continue breastfeeding, and combine childrearing with their other responsibilities (McFadden et al., 2017; Negron et al., 2013). Such women are thus among those most affected by the pandemic (Kotlar et al., 2021).

Breastfeeding benefits maternal and child health (Rollins et al., 2016; Victora et al., 2016), and because it is a learned behavior, women need continuous support during pregnancy, at delivery, and after birth (McFadden et al., 2017; Brown, 2017; Emmott, Page & Myers, 2020; Nanishi, Green & Hongo, 2021), even during the COVID-19 pandemic. However, physical distancing and an overextended health system could reduce appropriate support and discourage women from starting and continuing breastfeeding (Vazquez-Vazquez et al., 2021; Ceulemans et al., 2020; Brown & Shenker, 2021). A study of UK mothers who had breastfed their babies aged 0–12 months at least once during the COVID-19 pandemic found that some reported that the pandemic positively influenced breastfeeding because
of the increased time at home, reduced pressure, and presence of fewer visitors. For those who lacked sufficient access to breastfeeding support, however, breastfeeding during the pandemic was challenging (Brown & Shenker, 2021). Mothers with less education and more challenging living circumstances, and those of Black or other minority ethnic backgrounds, were more likely to stop breastfeeding during the pandemic (Brown & Shenker, 2021).

Health professionals are crucial to successful breastfeeding, but the pandemic could indirectly affect breastfeeding support. The World Health Organization (WHO) recommends ten steps to support breastfeeding (World Health Organization, 2017; World Health Organization, UNICEF, 2009), and existing evidence indicates that compliance with these recommendations improves breastfeeding outcomes (Hannula, Kaunonen & Tarkka, 2008; Merten, Dratva & Ackermann-Liebrich, 2005). Specifically, mothers are more likely to breastfeed when professionals help them practice skin-to-skin contact and initiate breastfeeding soon after birth, learn sufficient breastfeeding skills, stay roomed-in with their infant, and respond to infants’ cues (Merten, Dratva & Ackermann-Liebrich, 2005). However, health professionals may deprioritize such practices during a pandemic, when they lack a clear message encouraging breastfeeding support.

The indirect effects of the COVID-19 pandemic on professional breastfeeding support have not been carefully examined. This is of particular interest because women become mothers and need continuous support for breastfeeding even during pandemics, and breastfeeding promotes infant and maternal health. A study in Italy suggested that the rate of exclusive breastfeeding was lower during than before the pandemic (Latorre et al., 2021). However, the extent to which professional breastfeeding support is affected by the pandemic is unknown. Therefore, we examined maternal breastfeeding intention and professional breastfeeding support before and during the pandemic in Japan and analyzed any differences. We further assessed if compliance with WHO recommendations for infant feeding support was effective in promoting exclusive breastfeeding during the pandemic.

**MATERIALS & METHODS**

**Study design and participants**

We used the STROBE cross sectional checklist when writing our report (von Elm et al., 2007) (Table S1). This cross-sectional, internet-based questionnaire survey was conducted as a part of the Japan COVID-19 and Society Internet Survey (JACSIS) study, which addresses public health issues related to the COVID-19 pandemic. The study sample for the project was retrieved from the pooled panels of an internet research agency (Rakuten Insight, 2016), which had approximately 2.2 million panelists in Japan in 2019. The current study targeted pregnant and postpartum women. Among the 21,896 women in the panel who had given birth after 1 October 2019 or were expected to give birth by 31 March 2021, 4,373 were selected by simple random sampling and invited to the survey by e-mail. Data collection was started on 15 October 2020 and ended on 25 October 2020, when the targeted sample size of 1,000 was attained (response rate, 22.9%). The sample size of 1,000 was decided based on feasibility to conduct the research. Details of the sampling strategy are described elsewhere (Okawa et al., 2022).
The inclusion criteria of the study sample were women who had a live birth from 1 October 2019 through 25 October 2020 and pregnant women expected to have a delivery by 31 March 2021. Out of the 1,000 pregnant and postpartum women who participated, we excluded those with any invalid response \((n = 74)\) and those still pregnant at the time of survey \((n = 400)\), because the focus of this study was breastfeeding support and practice. Among the 558 women who had a live birth by the time of the survey and gave valid responses, those with a medical condition that could affect breastfeeding were excluded. Specifically, we excluded women who gave birth before 37 weeks of gestation \((n = 23)\), those whose infants were admitted to a neonatal intensive care unit \((n = 39)\), those with a health condition that stopped them from seeing their infant for longer than 1 day \((n = 35)\), those who had multiple births \((n = 14)\), and those who had undergone cesarean delivery because of COVID-19 \((n = 1)\). Some mothers satisfied multiple exclusion criteria. Ultimately, 484 women with a healthy live singleton birth were included in the analysis (Fig. 1).

A delivery on 5 March 2020 or earlier was classified as a before-pandemic delivery and a delivery on 6 March 2020 or later as a during-pandemic delivery. The precise start date of the pandemic is a matter of debate. The first case of COVID-19 in Japan was detected on 14 January 2020, and the first state of emergency, declared on 7 April 2020, originally targeted seven of the 47 prefectures and was later expanded to include the entire country. This pattern reflects how COVID-19 cases per population differed by prefecture. By 12 March 2022, Japan had 5.7 million diagnosed cases and 26 thousand deaths of COVID-19.
The deaths per 100,000 population were 20.65 on 13 March 2022, which was below many OECD countries, such as 294.77 in the United States, and 151.06 in Germany (The Johns Hopkins Coronavirus Resource Center, 2022). Because the focus of this study was the indirect effect of the pandemic on breastfeeding, we decided to establish a pandemic start date that reflected the time point when health professionals’ infant feeding care might have changed. The three major obstetrics academic societies in Japan published a joint statement on 5 March 2020, which recommended that if a woman with COVID-19 has a delivery, the infant should be completely separated from the mother and breastfeeding avoided (Japan Society for Infectious Diseases in Obstetrics and Gynecology, Japan Society of Obstetrics and Gynecology & Japan Association of Obstetricians and Gynecologists, 2021). Because this statement could have changed professional practices, we defined the cut-off date as 5 March 2020. Two major academic societies, in pediatrics and neonatology, later stated that breast milk was less likely to transmit SARS-CoV-2 and thus included breastfeeding as a feeding option even when a mother had received a diagnosis of COVID-19 (Japan Pediatric Society, 2021; Japan Society for Neonatal Health and Development, 2021). Nevertheless, the policy of mother–infant separation has not changed as of this writing. The nationwide survey investigated 540 women diagnosed with COVID-19 during pregnancy between 1 January 2020 and 31 January 2022, and found that 94% were separated from their newborns and 59% formula-fed entirely at a hospital if they delivered within two weeks of the diagnosis (Deguchi & Yamada, 0000).

Measurements

Breastfeeding support from medical professionals

Professional breastfeeding support was measured in two ways: by assessing infant feeding care provided by obstetric ward staff and by examining uptake of regular maternal and child health services from pregnancy through the postpartum period. Infant feeding support by obstetric ward staff was measured in relation to compliance with the Ten Steps to Successful Breastfeeding (hereafter referred to as the Ten Steps) recommended by the WHO and Unicef (World Health Organization, UNICEF, 2009). Among the ten steps recommended, we measured five steps that could be assessed by means of maternal self-report and would likely exhibit variability among mothers in Japan. Table S2 summarizes the ten steps and the basis of the selection of the five steps. Briefly, we measured receipt of five steps at the hospital, namely, Steps 3, 4, 5, 7, and 8, which correspond to “discuss the importance and management of breastfeeding with women and their families,” “facilitate immediate skin-to-skin contact and support mothers to initiate breastfeeding as soon as possible after birth,” “support mothers to manage common breastfeeding difficulties,” “enable mothers and their infants to practice rooming-in 24 h a day,” and “support mothers to respond to their infants’ cues for breastfeeding every time.” These questions were developed by the authors. We carefully chose plain Japanese language for each question (Table S3) and did not conduct a pilot test among mothers.

In Japan, antenatal and postpartum health services for the mother, parents, and infants are an opportunity to augment breastfeeding counseling provided as part of in-hospital
To measure access to professional breastfeeding support during this routine care, participants were asked to recall provision of antenatal health check-ups and mother/parent classes, newborn home visits, and infant health check-ups and immunizations.

**Infant feeding status**

Infant feeding status at the time of the survey was measured among women with infants younger than 5 months. The WHO and many other organizations recommend exclusive breastfeeding during the first 6 months of life (World Health Organization, 2002; Section on Breastfeeding, American Academy of Pediatrics, 2012). One of the indicators to monitor the achievement of the goal is exclusive breastfeeding under six months; the percentage of infants 0–5 months of age who were fed exclusively with breast milk during the previous day. Specifically, the numerator is infants 0–5 months of age who were fed only breast milk during the previous day, and the denominator is infants 0–5 months of age (World Health Organization, UNICEF, 2021). This point-in-time “exclusive breastfeeding” rate is often used in cross-sectional studies (Gupta et al., 2017) in order to include infants under 6 months and obtain a large enough sample size with reasonable cost (Greiner, 2014). Because the current study is a cross-sectional study, we adopted the point-in-time measurement to assess the infant feeding status. There is no recommendation for the duration of exclusive breastfeeding in Japan. Instead, the Japanese guidelines for professional support of infant and young child feeding recommend starting complementary feeding at age 5 to 6 months (Study Group on Revision of Support Guide for Breastfeeding and Weaning, 2019). Therefore, the breastfeeding status of infants younger than 5 months was measured in this study. Mothers were asked what was given to infants during the 24 h before the survey. Infant feeding status was then classified as exclusive breastfeeding (i.e., no foods or liquids given other than breast milk), combination feeding breastfeeding (i.e., breast milk and formula milk or other foods/liquids was given), and formula feeding (i.e., no breast milk was given). It should be noted that “exclusive breastfeeding” measured in the current study corresponds to the indicator of infant feeding status recommended by the WHO and the United Nations Children’s Fund (UNICEF) (World Health Organization, UNICEF, 2021) and does not indicate exclusive breastfeeding from birth to six months of age, which is a public health goal recommended by the WHO (World Health Organization, UNICEF, 2009).

**Breastfeeding intention and other factors that might affect breastfeeding**

In addition to maternal intention of breastfeeding, the following factors known to be associated with breastfeeding were analyzed: socioeconomic background, the mental condition of mothers, and social factors, including work status and marketing of breast milk substitutes. Mothers described their original infant feeding intention as “definitely wanted to breastfeed,” “wanted to breastfeed, if possible,” “wanted to feed a combination of breast milk and formula milk,” and “did not have a specific plan.” Those who chose the first two options were considered to have an intention to breastfeed.
Analysis
The chi-square test or Fisher’s exact test was used to compare mothers who delivered before and during the pandemic in relation to their characteristics, breastfeeding intention, and provision of breastfeeding support. Descriptive statistics are used to describe the infant feeding status of mothers with an infant younger than 5 months. Finally, logistic regression analysis was used to examine if provision of infant feeding support that adhered to the Ten Steps was associated with exclusive breastfeeding of infants younger than 5 months during the previous day of the survey. Factors known to be associated with breastfeeding were considered potential confounders and entered into the model. On the basis of previous studies, the potential confounders evaluated were age, marital status, education level, household income, work status, mode of delivery, parity, depressive symptoms, intention, support from family and the partner, marketing of breast milk substitutes, and professional support through regular health check-ups (i.e., mother/parent classes and newborn home visits in this study) (Kaneko et al., 2006; Donath, Amir & Team, 2003; Amir & Donath, 2008; Cohen et al., 2018; Dennis & McQueen, 2009). However, marital status, work status, and uptake of newborn home visits were not included because of their lack of variability. Analyses were restricted to individuals with complete data for all variables required for each analysis. A p-value of 0.05 or less was considered to indicate statistical significance. All analyses were conducted using SPSS version 27.0.

Ethical considerations
This study was approved by the Institutional Review Board of the Osaka International Cancer Institute (No. 20084) and the Ethical Committee of the Graduate School of Medicine, the University of Tokyo (No. 2020336NI). This internet survey was conducted anonymously. Not answering the questionnaire was deemed as non-consent.

RESULTS
Characteristics of participants
Table 1 shows the background characteristics of the participants, including infant feeding intention. Mothers who delivered before the pandemic (n = 135) and during the pandemic (n = 349) were compared. In addition, the characteristics of mothers with an infant younger than 5 months (i.e., those who had reported infant feeding methods at the time of the survey) are presented. These 189 mothers are a subgroup of the 349 mothers who delivered during the pandemic. The two groups did not significantly differ in relation to socioeconomic background or cesarean delivery rate, but intention to breastfeed during the pandemic was lower for mothers who delivered during the pandemic than for those who delivered before the pandemic. While 82.2% of women with a delivery before the pandemic intended to breastfeed, the rate was 75.6% during the pandemic (p = 0.120). During the pandemic, only 33.2% of mothers had a delivery in the presence of their partner, and more than 95.1% of mothers reported that family members were not allowed to visit the hospital. Support from family and friends also changed during the pandemic. As compared with mothers who delivered before the pandemic, those who delivered during the pandemic were more likely to report that they could not receive child care support from the infant’s
Table 1  Characteristics of participants, breastfeeding intention, exposure to marketing of breast milk substitutes, and delivery and child-rearing environment. The second column from the right is the data of a subgroup of those who delivered during the pandemic and also had an infant under five months of age. The rightmost column compares those who gave birth before the pandemic and those who gave birth during the pandemic.

| Age (Mean, Standard Deviation) | Delivery before pandemic | Delivery during pandemic | Infant age ≤5 months at time of survey | Delivery before vs. during pandemic p value |
|-------------------------------|-------------------------|-------------------------|----------------------------------------|-------------------------------------------|
|                               | Delivery before pandemic | Delivery during pandemic | Infant age ≤5 months at time of survey | Delivery before vs. during pandemic p value |
| Age (Mean, Standard Deviation) | 32.1 (4.1)              | 32.3 (3.4)              | 32.2 (4.1)                              | 0.726                                      |
| Less than 16 years of formal education | 64 (47.4%)              | 175 (50.4%)             | 96 (51.3%)                              | 0.551                                      |
| Single mother                 | 0 (0 %)                 | 3 (0.9%)                | 0 (0 %)                                 | 0.280                                      |
| Unintended pregnancy          | 22 (16.3%)              | 50 (14.3%)              | 25 (13.2%)                              | 0.585                                      |
| Low household income          | 27 (20.0%)              | 55 (15.8%)              | 27 (14.3%)                              | 0.265                                      |
| Cesarean delivery             | 28 (20.7%)              | 60 (17.2%)              | 28 (14.8%)                              | 0.364                                      |
| Partner present during labor  | 80 (59.3%)              | 116 (33.2%)             | 59 (31.2%)                              | <0.001                                     |
| Family members not allowed to visit after delivery | 21 (15.6%)              | 332 (95.1%)             | 181 (95.8%)                             | <0.001                                     |
| Primipara                     | 70 (51.9%)              | 178 (51.0%)             | 85 (45.0%)                              | 0.867                                      |
| Intended breastfeeding during pregnancy | 111 (82.2%)            | 264 (75.6%)             | 143 (75.7%)                             | 0.120                                      |
| Ever received free infant formula sample or invitation to free infant formula campaign | 102 (75.6%)             | 267 (76.5%)             | 152 (80.4%)                             | 0.826                                      |
| Unable to receive childcare support from grandparents after delivery | 19 (14.1%)              | 96 (27.5%)              | 45 (23.8%)                              | 0.002                                      |
| Unable to talk with friends for infant feeding and caring advice | 14 (10.4%)              | 53 (15.2%)              | 24 (12.7%)                              | 0.169                                      |
| Currently working outside home | 22 (16.3%)              | 18 (5.2%)               | 8 (4.2%)                                | <0.001                                     |
| Edinburgh Postnatal Depression Scale score (Mean, Standard Deviation) | 8.2 (5.7)               | 6.7 (4.9)               | 6.7 (4.9)                               | 0.015                                      |
| Partner support scale score (Mean, Standard Deviation) | 6.9 (2.4)               | 7.4 (2.1)               | 7.5 (2.0)                               | 0.021                                      |

Notes.

4Delivery on 5 March 2020 or earlier in Japan.
5Delivery on 6 March 2020 or later in Japan.
6Subgroup of mothers who delivered during the pandemic.
7The chi-square test or T-test was performed, if not specified.
8Fisher’s exact test was performed.
9Annual household income of ≤4 million yen (about 36,000 USD).
10A higher score indicates more depressive symptoms at the time of the survey, not status at delivery.
11A higher score indicates more support for childcare from the partner at the time of the survey, not status at delivery. The Cronbach’s alpha for the scale in this study was 0.90.

Infant feeding support from medical professionals before and during the pandemic

Table 2 compares infant feeding support from medical professionals for mothers with deliveries before and during the pandemic. Women who delivered during the pandemic were more likely to report no or reduced opportunity to attend classes for mothers/parents (33.3% before the pandemic vs. 75.1% during the pandemic; p < 0.001). However, most
Table 2  Infant feeding support from medical professionals. The second column from the right is the data of a subgroup of those who delivered during the pandemic and also had an infant under five months of age. The rightmost column compares those who gave birth before the pandemic and those who gave birth during the pandemic.

| Provision of the Ten Steps to Successful Breastfeeding | Delivery before pandemic<sup>a</sup><br>n = 135 | Delivery during pandemic<sup>b</sup><br>n = 349 | Infant age <5 months at time of survey<br>n = 189 | Delivery before vs. during pandemic<sup>c</sup> (p value<sup>d</sup>) |
|-------------------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|
| Reduced frequency of antenatal care visits            | 3 (2.2%)                                    | 19 (5.4%)                                   | 11 (5.8%)                                   | 0.150<sup>e</sup>                           |
| No or reduced chance to attend maternal/parent classes during pregnancy | 45 (33.3%)                                  | 262 (75.1%)                                 | 155 (82.0%)                                 | <0.001<sup>f</sup>                           |
| No postnatal home visit<sup>g</sup>                   | 15 (11.1%)                                  | 61 (17.5%)                                  | 19 (10.1%)                                  | 0.084<sup>g</sup>                           |
| Skipped infant health check-up or immunization<sup>h</sup> | 18 (13.3%)                                  | 19 (5.4%)                                   | 7 (3.7%)                                    | 0.003<sup>i</sup>                           |
| Step 3<sup>j</sup>                                     | 115 (85.2%)                                 | 274 (78.5%)                                 | 149 (78.8%)                                 | 0.097<sup>j</sup>                           |
| Step 4<sup>k</sup>                                     | 62 (45.9%)                                  | 139 (39.8%)                                 | 76 (40.2%)                                  | 0.222<sup>k</sup>                           |
| Step 5<sup>i</sup>                                     | 106 (78.5%)                                 | 275 (78.7%)                                 | 146 (77.2%)                                 | 0.947<sup>i</sup>                           |
| Step 7<sup>j</sup>                                     | 53 (39.3%)                                  | 97 (27.8%)                                  | 50 (26.5%)                                  | 0.014<sup>j</sup>                           |
| Step 8<sup>j</sup>                                     | 101 (74.8%)                                 | 264 (75.6%)                                 | 143 (75.7%)                                 | 0.849<sup>j</sup>                           |
| Number of steps practiced (Mean, Standard Deviation)   | 3.24 (1.24)                                 | 3.01 (1.26)                                 | 2.98 (1.25)                                 | 0.069<sup>j</sup>                           |
| Received all five steps                                | 23 (17.0%)                                  | 43 (12.3%)                                  | 22 (11.6%)                                  | 0.175<sup>j</sup>                           |

Notes.

<sup>a</sup>Delivery on 5 March 2020 or earlier in Japan.
<sup>b</sup>Delivery on 6 March 2020 or later in Japan.
<sup>c</sup>Comparison between mothers who had a delivery before and during the pandemic.
<sup>d</sup>Fisher’s exact test was performed.
<sup>e</sup>Includes both cancellation from the service provider and opt-out by the mother.
<sup>f</sup>Confounded by infant age; infants born before the delivery had more opportunity to be invited to infant health check-ups and immunization by the time of the survey.
<sup>g</sup>Learned during the pregnancy the benefits and techniques of breastfeeding.
<sup>h</sup>Initiated breastfeeding within 30 minutes of delivery.
<sup>i</sup>Learned in hospital how to feed the baby in the manner desired.
<sup>j</sup>Roomed-in with the baby since soon after birth.
<sup>k</sup>On-demand feeding (breastfed every time the baby demanded) in hospital.

did not reduce the frequency of antenatal care visits and did not opt-out of the antenatal home visit. There was no significant difference in receipt of such care between the two groups (p = 0.150 and p = 0.084, respectively). Only 5.4% skipped a scheduled infant health check-up or immunization during the pandemic.

Mothers who delivered during the pandemic were less likely to receive breastfeeding support that complied with WHO recommendations than were those who delivered before the pandemic. Analysis of the five steps showed that significantly fewer women received Step 7 (roomed-in with their baby since soon after birth) during the pandemic (39.3% before the pandemic vs. 27.8% during the pandemic; p = 0.014). In addition, fewer women satisfied Step 3 (learned enough during pregnancy the breastfeeding benefits and techniques; 85.2% before the pandemic vs. 78.5% during the pandemic; p = 0.097) and Step 4 (initiation of breastfeeding within 30 min of delivery; 45.9% before the pandemic vs. 39.8% during the pandemic; p = 0.222), although the differences were not significant. The average number of steps achieved in compliance with the Ten Steps was 3.24 before the pandemic and 3.01 during the pandemic (p = 0.069). Only 17% of those who delivered
Feeding status of infants younger than 5 months. The second left column shows data of all mothers with infants younger than five months. The second right and rightmost columns showed data by original feeding intention during pregnancy.

| All mothers with infants younger than 5 months (n = 189) | Original feeding intention during pregnancy |
|--------------------------------------------------------|---------------------------------------------|
|                                                        | Breastfeeding (n = 143)                      | Mixed feeding, formula feeding, or no clear intention (n = 46) |
| Exclusive breastfeeding b                              | 70 (37.0%)                                  | 61 (42.7%)                                             |
| Partial breastfeeding b                                | 96 (50.8%)                                  | 67 (46.9%)                                             |
| Formula feeding b                                      | 23 (12.2%)                                  | 15 (10.5%)                                             |
|                                                        |                                             | 9 (19.6%)                                              |
|                                                        |                                             | 29 (63.0%)                                             |
|                                                        |                                             | 8 (17.4%)                                              |

Notes.

b Subgroup of participants who had a delivery during the pandemic (on 6 March 2020 or later) in Japan.

Before the pandemic reported the provision on all five steps measured, and the rate was 12.3% during the pandemic (p = 0.175).

Feeding status of infants younger than 5 months

Infant feeding status at the time of survey was analyzed among 189 mothers who delivered during the pandemic and had infants younger than 5 months; only 70 (37.0%) reported that they exclusively breastfed during the 24 h before the survey (Table 3). Even among the 143 mothers who intended exclusive breastfeeding during pregnancy, only 61 (42.7%) reported exclusive breastfeeding during the 24 h before the survey.

Number of steps practiced and feeding status of infants younger than 5 months

Table 4 shows the feeding status of infants younger than 5 months, stratified by the number of the breastfeeding support steps received. Among mothers reporting that they received 0 to 4 steps, the rate of exclusive breastfeeding during the 24 h before the survey ranged from 27.8% to 40.0%. However, among the 22 mothers who reported receipt of all five steps, the rate was 72.7%.

Factors associated with exclusive breastfeeding during the 24 h before the survey

Multiple logistic regression analysis indicated that, after adjusting for possible confounders, provision of all five steps of the Ten Steps promoted exclusive breastfeeding during the 24 h before the survey of infants younger than 5 months (adjusted odds ratio 4.51; 95% CI [1.50–13.61]). In addition, receipt of a free formula sample or invitation to a free sample campaign was significantly associated with a reduction in exclusive breastfeeding during the 24 h before the survey (adjusted odds ratio 0.43; 95% CI [0.19–0.98]), as were older maternal age, lower education level, primiparity, and breastfeeding intention (Table 5).
Table 4  Feeding status of infants younger than 5 months\(^a\), by number of breastfeeding support steps received. The leftmost column shows the number of steps practiced and the number of the mothers who received that number of practice. For example, five mothers received no step. Each data in the other columns show the numbers of mothers/total mothers responded (%) and the number of mothers by infant feeding status.

| Number of steps practiced\(^b\) \((n = 189)\) | Exclusive breastfeeding | Partial breastfeeding | Formula feeding |
|---------------------------------------------|-------------------------|----------------------|-----------------|
| 0 \((n = 5)\)                               | 40.0% (2)               | 20.0% (1)            | 40.0% (2)       |
| 1 \((n = 18)\)                              | 27.8% (5)               | 55.6% (10)           | 16.7% (3)       |
| 2 \((n = 42)\)                              | 31.0% (13)              | 54.8% (23)           | 14.3% (6)       |
| 3 \((n = 56)\)                              | 32.1% (18)              | 55.4% (31)           | 12.5% (7)       |
| 4 \((n = 46)\)                              | 34.8% (16)              | 56.5% (26)           | 8.7% (4)        |
| 5 \((n = 22)\)                              | 72.7% (16)              | 22.7% (5)            | 4.5% (1)        |

Notes.
\(^a\)Measured by a 24-hour recall among the subgroup of participants who had a delivery during the pandemic (on 6 March 2020 or later) in Japan.
\(^b\)Among the Ten Steps to Successful Breastfeeding recommended by the WHO, provision of five steps (Steps 3, 4, 5, 7, and 8) were assessed.

Table 5  Factors associated with exclusive breastfeeding of infants younger than 5 months\(^a\). Each data indicates an unstandardized coefficient, \(p\)-value, adjusted odds ratio, and its lower and upper limits of the 95% confidence interval of each variable entered in the model.

|                                      | Unstandardized coefficient | \(P\)  | Adjusted Odds Ratio | Lower limit of the 95% CI | Upper limit of the 95% CI |
|--------------------------------------|-----------------------------|--------|---------------------|---------------------------|---------------------------|
| Age                                  | −0.122                      | 0.010  | 0.885               | 0.807                     | 0.971                     |
| More than university graduate level of education | 0.856                      | 0.020  | 2.354               | 1.146                     | 4.836                     |
| Low household income                 | 0.381                       | 0.516  | 1.464               | 0.463                     | 4.630                     |
| Cesarean delivery                    | −0.458                      | 0.401  | 0.633               | 0.217                     | 1.842                     |
| Primiparity                          | −1.073                      | 0.008  | 0.342               | 0.154                     | 0.759                     |
| Edinburgh Postnatal Depression Scale score | −0.021                     | 0.594  | 0.98                | 0.908                     | 1.057                     |
| Intended breastfeeding during pregnancy | 0.936                      | 0.043  | 2.551               | 1.031                     | 6.31                      |
| Partner support scale score\(^b\)    | −0.041                      | 0.662  | 0.960               | 0.799                     | 1.153                     |
| Unable to receive childcare support from grandparents after delivery | −0.377                      | 0.395  | 0.686               | 0.288                     | 1.635                     |
| Ever received free infant formula sample or invitation to a free infant formula campaign | −0.852                      | 0.046  | 0.427               | 0.185                     | 0.984                     |
| No or reduced opportunity for parental/maternal class during pregnancy | 0.682                      | 0.161  | 1.978               | 0.761                     | 5.136                     |
| Received all five steps              | 1.507                       | 0.007  | 4.514               | 1.497                     | 13.61                     |

Notes.
\(^a\)Measured by a 24-hour recall among the subgroup of participants who had a delivery during the pandemic (on 6 March 2020 or later) in Japan.
\(^b\)Measured using three questions with a four-point Likert scale developed by the authors. The total score ranges from 0 to 9. A higher score indicates more support for childcare from the partner at the time of the survey, not status at delivery. The Cronbach’s alpha for the scale in this study was 0.90.

DISCUSSION

This study of healthy mothers in Japan found that mothers with a delivery during the COVID-19 pandemic received less breastfeeding support than mothers who had a delivery before the pandemic. Compared with mothers who delivered before the pandemic, those who delivered during the pandemic were less likely to receive professional breastfeeding...
support that complied with WHO recommendations. Although the difference was not significant, mothers who delivered during the pandemic were less likely to intend to breastfeed than were those who delivered before the pandemic. Moreover, among those who had an infant younger than 5 months, there was a wide gap between their original breastfeeding intention and their practice at the time of the survey. These findings suggest that the COVID-19 pandemic affected breastfeeding intention, professional breastfeeding support, and breastfeeding outcomes of healthy mothers.

We found that the quality of in-hospital infant feeding care might be affected by the pandemic, even when accessibility to maternal and infant health services might not be seriously disrupted. Previous studies in low- and middle-income countries suggested that by decreasing access to health care, the COVID-19 pandemic might have considerable indirect effects on maternal and child health (Roberton et al., 2020). In contrast, this study found no significant reduction in the uptake of antenatal care, neonatal home visits, or infant health check-ups. However, compliance with WHO recommendations on breastfeeding support was reduced. In particular, the rate of mothers who achieved Step 7 (“roomed-in with the baby since soon after birth”) was lower during the pandemic. Because mothers with a medical condition or with an infant who had a medical condition were excluded from the analysis, this finding suggests that more mothers were separated from their infants for non-medical reasons during the pandemic. Mother–infant separation may affect maternal and infant well-being (Bartick et al., 2021), increases the risks of breastfeeding difficulties (Cohen et al., 2018; Moore et al., 2016), and interrupts mother–infant interactions (Dumas et al., 2013; Bystrova et al., 2009). To reduce the indirect negative impact of the COVID-19 pandemic on maternal and child health, clear messaging and guidance should be provided to health professionals, to ensure they are able to maintain the highest possible quality of infant feeding care.

During the pandemic, receipt of WHO-compliant breastfeeding support was positively associated with exclusive breastfeeding of infants younger than 5 months, which was measured by 24-hour recall. Most of our participants, however, did not receive such support. This association is consistent with multiple pre-pandemic studies that provided evidence supporting the Ten Steps (World Health Organization, 2017). We evaluated receipt of five steps out of the Ten Steps and found that partial receipt of the five steps does not ensure exclusive breastfeeding. Several possibilities could explain why providing all five steps is necessary for effective support. The first is that “full support,” namely, receipt of Steps 3, 4, 5, 7, and 8, encourages exclusive breastfeeding. Full support encompasses informative support during pregnancy (i.e., Step 3: “discuss the importance and management of breastfeeding with women and their families”), physical contact between the infant and mother soon after birth (i.e., Step 4: “facilitate immediate skin-to-skin contact and support mothers to initiate breastfeeding as soon as possible after birth,” and Step 7: “enable mothers and their infants to practice rooming-in 24 h a day”), and practical help on breastfeeding techniques (i.e., Step 5: “support mothers to manage common breastfeeding difficulties,” and Step 8: “support mothers to respond to their infants’ cues for breastfeeding every time”). The absence of any step of full support could hinder breastfeeding. Hospital characteristics may also explain the positive association between full support and exclusive
breastfeeding. Hospitals providing full support might have specific characteristics that enabled mothers to breastfeed exclusively. For example, some of the mothers who reported receiving all five steps might have delivered at Baby Friendly–certified hospitals, which provide infant feeding practices that are consistent with the Ten Steps. However, because only 2% of obstetric wards are Baby Friendly–certified in Japan (Japan Breast Feeding Association, 2019), such certification might not be the only characteristic that explains the finding.

The reduction in breastfeeding support during the pandemic might be attributable in part to the unique context of Japan. When the study was conducted, no vaccination was available for SARS-CoV-2, and physical distancing was an important means to control disease transmission. Although data collected before the present study showed an infection rate of only 0.02% among pregnant women (Japan Association of Obstetricians and Gynecologists, 2021), medical professionals might have regarded mother–infant separation as a means to reduce the risk of virus transmission. They might also have concluded that the harms of breastfeeding cessation were less than those of COVID-19. In addition, there has been no clear message from the Ministry of Health, Labor and Welfare, or from any other relevant health organization in Japan, that breastfeeding support is an essential health service that should be provided even during the pandemic. Instead, authorities repeatedly recommended that mothers infected with SARS-CoV-2 be separated from their newborns for at least the initial 48 h after delivery (Japan Society for Infectious Diseases in Obstetrics and Gynecology, Japan Society of Obstetrics and Gynecology & Japan Association of Obstetricians and Gynecologists, 2021), which contradicts recent evidence showing that breastfeeding benefits maternal and infant health, regardless of SARS-CoV-2 infection status (Zhu et al., 2021), and that infants should not be separated merely because of the infection (Salvatore et al., 2020; Ronchi et al., 2021; Dumitriu et al., 2021). The absence of an evidence-based recommendation that encouraged breastfeeding support could have reduced awareness among health professionals, especially when the health system was under severe pressure during the pandemic.

Another factor to be considered is that Japan has long failed to develop a clear strategy for breastfeeding promotion that targets health professionals and the public. An unsatisfied intention to breastfeed can lead to maternal guilt, and some people believe that such conflicted feelings are caused by breastfeeding promotion (Matsumoto & Tabuchi, 2019), not by insufficient support. Perhaps in light of this hypothesis, Japanese health authorities have not clearly endorsed exclusive breastfeeding for the first 6 months. The latest professional guidelines for the feeding of infants and young children devotes only two sentences of a 54-page document to summarizing the benefits of breastfeeding (Study Group on Revision of Support Guide for Breastfeeding and Weaning, 2019). The low priority assigned to breastfeeding, even before the pandemic, might have contributed to rapid withdrawal of breastfeeding support to healthy dyads during the pandemic in Japan.

Receipt of a free formula sample or invitation to a free sample campaign was negatively associated with exclusive breastfeeding, besides the incompliance to the Ten Steps. Although Japan voted for the International Code of Marketing of Breast-Milk Substitutes, which prohibits the distribution of free formula samples (World Health Organization, 1981), Japan
has no legal regulation on the Code (World Health Organization, 2020). The current study found that most women received the free sample or an invitation to a free infant formula campaign, which was a major risk factor of not exclusively breastfeeding. Aggressive marketing of infant formula is a well-known obstacle to breastfeeding and therefore affects child health (Clark et al., 2020). The results suggest legal regulations on marketing of infant formula in Japan should be considered.

Several limitations of this study should be mentioned. First, the possibility of selection bias cannot be ruled out. The women on the survey company’s panel were not randomly selected from the population of Japan. Further, we did not intend to achieve a high response rate (i.e., we aimed to recruit the first 1,000 respondents among the 4,373 invited women). Mothers with negative experiences of childbirth or breastfeeding might be more likely to ignore invitations to participate in such a survey. Therefore, the current study might have led to the selection of fewer women with negative breastfeeding experiences. Second, all data were collected by self-report, which is subject to social desirability bias. For example, reported breastfeeding outcomes may be better than actual outcomes. Nevertheless, we believe that use of an online panel was appropriate for recruiting postpartum women from a wide geographical area in Japan during a pandemic. Finally, the two groups, women who had a delivery before the pandemic and those who had a delivery during the pandemic, might not be comparative because of the cross-sectional study design. Although the two groups were not significantly different in sociodemographic and obstetric background, the difference in breastfeeding support and outcomes between the two groups can be attributed to unmeasured factors.

Limitations notwithstanding, the present findings highlight how the COVID-19 pandemic might indirectly weaken breastfeeding support for healthy mothers and infants. To our knowledge, this is one of only a few studies to evaluate professional breastfeeding support for healthy dyads during the COVID-19 pandemic. The current study also suggested that breastfeeding support adherence to the WHO recommendations might effectively ensure exclusive breastfeeding during the pandemic. The implication for public health is to emphasize maintaining breastfeeding support for healthy dyads. Considering short-term and long-term breastfeeding benefits (Rollins et al., 2016; Victora et al., 2016), breastfeeding support adherent to the WHO recommendations (World Health Organization, 2017; World Health Organization, UNICEF, 2009) might reduce the indirect adverse effects of the pandemic on non-infected mothers and infants.

CONCLUSIONS

In conclusion, the COVID-19 pandemic weakened breastfeeding support for healthy women in Japan; however, support practice that adhered to WHO recommendations appeared to be effective during the pandemic. Because breastfeeding yields long-term health benefits for mothers and infants, we suggest efforts to provide appropriate breastfeeding support even during the pandemic.
ACKNOWLEDGEMENTS

The authors would like to thank Dr. Joseph Green for comments and suggestions on an earlier version of the manuscript and David Kipler, ELS, for English editing.

ADDITIONAL INFORMATION AND DECLARATIONS

Funding
This study was funded by the Japan Society for the Promotion of Science (JSPS) KAKENHI Grants, 18H03062 (Takahiro Tabuchi) and 21H04856 (Takahiro Tabuchi and Sumiyo Okawa). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Grant Disclosures
The following grant information was disclosed by the authors:
Japan Society for the Promotion of Science.
KAKENHI: 18H03062, 21H04856.

Competing Interests
The authors declare there are no competing interests.

Author Contributions
• Keiko Nanishi conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, authored or reviewed drafts of the paper, and approved the final draft.
• Sumiyo Okawa, Sarah K. Abe and Takahiro Tabuchi conceived and designed the experiments, performed the experiments, authored or reviewed drafts of the paper, and approved the final draft.
• Hiroko Hongo performed the experiments, authored or reviewed drafts of the paper, and approved the final draft.
• Akira Shibanuma analyzed the data, authored or reviewed drafts of the paper, and approved the final draft.

Human Ethics
The following information was supplied relating to ethical approvals (i.e., approving body and any reference numbers):
This study was approved by the Institutional Review Board of the Osaka International Cancer Institute (No. 20084) and the Ethical Committee of the Graduate School of Medicine, the University of Tokyo (No. 2020336NI).

Data Availability
The following information was supplied regarding data availability:
The data is available at Zenodo: Keiko Nanishi. (2021). Breastfeeding support during COVID-19 pandemic in Japan [Data set]. Zenodo. https://doi.org/10.5281/zenodo.5775279.
Supplemental Information
Supplemental information for this article can be found online at http://dx.doi.org/10.7717/peerj.13347#supplemental-information.

REFERENCES

Amir LH, Donath SM. 2008. Socioeconomic status and rates of breastfeeding in Australia: evidence from three recent national health surveys. *Medical Journal of Australia* **189**(5):254–256 DOI 10.5694/j.1326-5377.2008.tb02016.x.

Bartick MC, Valdés V, Giusti A, Chapin EM, Bhana NB, Hernández-Aguilar MT, Duarte ED, Jenkins L, Gaughan J, Feldman-Winter L. 2021. Maternal and infant outcomes associated with maternity practices related to COVID-19: The COVID mothers study. *Breastfeeding Medicine* **16**(3):189–199 DOI 10.1089/bfm.2020.0353.

Brown A. 2017. Breastfeeding as a public health responsibility: a review of the evidence. *Journal of Human Nutrition and Dietetic* **30**(6):759–770 DOI 10.1111/jhn.12496.

Brown A, Shenker N. 2021. Experiences of breastfeeding during COVID-19: lessons for future practical and emotional support. *Maternal & Child Nutrition* **17**(1):e13088 DOI 10.1111/mcn.13088.

Bystrova K, Ivanova V, Edhborg M, Matthiesen AS, Ransjö-Arvidson AB, Mukhamedrakhimov R, Uvnäs-Moberg K, Widström A-M. 2009. Early contact versus separation: effects on mother-infant interaction one year later. *Birth* **36**(2):97–109 DOI 10.1111/j.1523-536X.2009.00307.x.

Ceulemans M, Verbakel JY, Van Calsteren K, Eerdekens A, Allegaert K, Foulon V. 2020. SARS-CoV-2 infections and impact of the COVID-19 pandemic in pregnancy and breastfeeding: results from an observational study in primary care in Belgium. *International Journal of Environmental Research and Public Health* **17**(18):6766 DOI 10.3390/ijerph17186766.

Clark H, Coll-Seck AM, Banerjee A, Peterson S, Dalglish SL, Ameratunga S, Balabanova D, Bhan MK, Bhutta ZA, Borrazzo J, Claeson M, Doherty T, El-Jardali F, George AS, Gichaga A, Gram L, Hipgrave DB, Kwamie A, Meng Q, Mercer R, Narain S, Nsungwa-Sabiti J, Olumide AO, Osrin D, Powell-Jackson T, Rasanathan K, Rasul I, Reid P, Requejo J, Rohde SS, Rollins N, Romedenne M, Singh Sachdev H, Saleh R, Shawar YR, Shiffman J, Simon J, Syl PD, Stenberg K, Tomlinson M, Ved RR, Costello A. 2020. A future for the world’s children? A WHO-UNICEF-Lancet Commission. *Lancet* **395**(10224):605–658 DOI 10.1016/S0140-6736(19)32540-1.

Cohen SS, Alexander DD, Krebs NF, Young BE, Cabana MD, Erdmann P, Hays NP, Bezold CP, Levin-Sparenberg E, Turini M, Saavedra JM. 2018. Factors associated with breastfeeding initiation and continuation: a meta-analysis. *The Journal of Pediatrics* **203**:190–196 DOI 10.1016/j.jpeds.2018.08.008.

Deguchi M, Yamada H. Nihon ni okeru COVID-19 ninpu no genjyo 2022. Available at https://www.jsog.or.jp/news/pdf/20220301_COVID19.pdf.
Dennis CL, McQueen K. 2009. The relationship between infant-feeding outcomes and postpartum depression: a qualitative systematic review. *Pediatrics* 123(4):e736-e751 DOI 10.1542/peds.2008-1629.

Donath SM, Amir LH, Team AS. 2003. Relationship between prenatal infant feeding intention and initiation and duration of breastfeeding: a cohort study. *Acta Paediatrica* 92(3):352–356 DOI 10.1111/j.1651-2227.2003.tb00558.x.

Dumas L, Lepage M, Bystrøva K, Matthiesen AS, Welles-Nyström B, Widström AM. 2013. Influence of skin-to-skin contact and rooming-in on early mother-infant interaction: a randomized controlled trial. *Clinical Nursing Research* 22(3):310–336 DOI 10.1177/1054773812468316.

Dumitru D, Emeruwa UN, Hanft E, Liao GV, Ludwig E, Walzer L, Arditi B, Saslaw M, Andrikopoulou M, Scripps T, Baptiste C, Khan A, Breslin N, Rubenstein D, Simpson LL, Kyle MH, Friedman AM, Hirsch DS, Miller RS, Fernández CR, Fuchs KM, Keown MK, Glassman ME, Stephens A, Gupta A, Sultan S, Sibbiles C, Whittier S, Abreu W, Akita F, Penn A, D’Alton ME, Orange JS, Goffman D, Saiman L, Stockwell MS, Gyamfi-Bannerman C. 2021. Outcomes of neonates born to mothers with severe acute respiratory syndrome coronavirus 2 infection at a large medical center in New York City. *JAMA Pediatrics* 175(2):157–167 DOI 10.1001/jamapediatrics.2020.4298.

Emmott EH, Page AE, Myers S. 2020. Typologies of postnatal support and breastfeeding at two months in the UK. *Social Science & Medicine* 246:112791 DOI 10.1016/j.socscimed.2020.112791.

Greiner T. 2014. Exclusive breastfeeding: measurement and indicators. *International Breastfeeding Journal* 9:18 DOI 10.1186/1746-4358-9-18.

Gupta PM, Perrine CG, Chen J, Elam-Evans LD, Flores-Ayala R. 2017. Monitoring the World Health Organization Global Target 2025 for exclusive breastfeeding: experience from the United States. *Journal of Human Lactation* 33(3):578–581 DOI 10.1177/0890334417693210.

Hannula L, Kaunonen M, Tarkka MT. 2008. A systematic review of professional support interventions for breastfeeding. *Journal of Clinical Nursing* 17(9):1132–1143 DOI 10.1111/j.1365-2702.2007.02239.x.

Japan Association of Obstetricians and Gynecologists. 2021. Results of the Fact-Finding Survey on New Coronavirus Infections [Shingata corona uirusu kansennshou (COVID-19) nitsuite no jittai chousa no kekka ni tsuite September 2020]. Available at https://www.jaog.or.jp/about/project/document/covid19_200916/ (accessed on 14 October 2021).

Japan Breast Feeding Association. 2019. List of the Baby Friendly Hospitals in Japan Tokyo, Japan: Japan Breast Feeding Association. Available at http://www.bonyu.or.jp/index.asp?patten_cd=126-amp;page_no=11 (accessed on 14 October 2021).

Japan Pediatric Society. 2021. Q&A on new coronavirus infection [Shingata corona uirusu kansenshou ni kansuru Q & A ni tsuite 27 August 2020]. Available at http://www.jpeds.or.jp/modules/activity/index.php?content_id=326 (accessed on 11 October 2021).
Japan Society for Infectious Diseases in Obstetrics and Gynecology, Japan Society of Obstetrics and Gynecology, Japan Association of Obstetricians and Gynecologists. 2021. Guidelines for healthcare professionals on the management of COVID-19 positive cases [Shingata kora uirusu kansenshou (COVID-19) eno taiou nitsuite iryoujyuujisha muke gaidorainn 05 August 2020]. Available at http://jsidog.kenkyuukai.jp/information/information_detail.asp?id=101608 (accessed on 05 October 2021).

Japan Society for Neonatal Health and Development. 2021. Management of newborns in the early postnatal period who were born to mothers with new coronavirus infection, 4th Edition [Shingata corona uirusu kansenshou ni taisuru shusseigo souki noshinseiji heno taiou ni tsuite dai 4 han 19 2020]. Available at http://jsnhd.or.jp/pdf/20201019COVID-19.pdf (accessed on 11 October 2021).

Johns Hopkins University and Medicine CRC. COVID-19 Dashboard, Global Map 2022. Available at https://coronavirus.jhu.edu/map.html (accessed on 13 March 2022).

Kaneko A, Kaneita Y, Yokoyama E, Miyake T, Harano S, Suzuki K, Ibuka E, Tsutsui T, Yamamoto Y, Ohida T. 2006. Factors associated with exclusive breast-feeding in Japan: for activities to support child-rearing with breast-feeding. Journal of Epidemiology 16(2):57–63 DOI 10.2188/jea.16.57.

Kotlar B, Gerson E, Petrillo S, Langer A, Tiemeier H. 2021. The impact of the COVID-19 pandemic on maternal and perinatal health: a scoping review. Reproductive Health 18(1):10 DOI 10.1186/s12978-021-01070-6.

Latorre G, Martinelli D, Guida P, Masi E, De Benedictis R, Maggio L. 2021. Impact of COVID-19 pandemic lockdown on exclusive breastfeeding in non-infected mothers. International Breastfeeding Journal 16(1):36 DOI 10.1186/s13006-021-00382-4.

Matsumoto C, Tabuchi S. 2019. Bonyu eno kado na kitai minaoshi - kuni shishinn kaitei arerugii kouka nashi. The Asahi Shinbun.

McFadden A, Gavine A, Renfrew MJ, Wade A, Buchanan P, Taylor J, Veitch E, Rennie AM, Crowther SA, Neiman S, MacGillivray S. 2017. Support for healthy breastfeeding mothers with healthy term babies. The Cochrane Database of Systematic Reviews 2:CD001141 DOI 10.1002/14651858.CD001141.pub5.

Merten S, Dratva J, Ackermann-Liebrich U. 2005. Do baby-friendly hospitals influence breastfeeding duration on a national level? Pediatrics 116(5):e702-e708 DOI 10.1542/peds.2005-0537.

Moore ER, Bergman N, Anderson GC, Medley N. 2016. Early skin-to-skin contact for mothers and their healthy newborn infants. The Cochrane Database of Systematic Reviews 11:CD003519 DOI 10.1002/14651858.CD003519.pub4.

Nanishi K, Green J, Hongo H. 2021. Development of the breastfeeding support scale to measure breastfeeding support from lay and professional persons, and its predictive validity in Japan. PeerJ 9:e11779 DOI 10.7717/peerj.11779.

Negron R, Martin A, Almog M, Balbierz A, Howell EA. 2013. Social support during the postpartum period: mothers' views on needs, expectations, and mobilization of support. Maternal and Child Health Journal 17(4):616–623 DOI 10.1007/s10995-012-1037-4.

Nanishi et al. (2022), PeerJ, DOI 10.7717/peerj.13347
Okawa S, Hosokawa Y, Nanishi K, Zaitsu M, Tabuchi T. 2022. Threatened abortion, threatened premature labor, and preterm birth during the first state of emergency for COVID-19 in 2020 in Japan. *Journal of Obstetrics and Gynaecology Research* DOI 10.1111/jog.15203.

Rakuten Insight. 2016. About us: Rakuten Insight. Available at https://insight.rakuten.com/about-us/ (accessed on 11 October 2021).

Roberton T, Carter ED, Chou VB, Stegmuller AR, Jackson BD, Tam Y, Sawadogo-Lewis T, Walker N. 2020. Early estimates of the indirect effects of the COVID-19 pandemic on maternal and child mortality in low-income and middle-income countries: a modelling study. *The Lancet Global Health* 8(7):e901-e8 DOI 10.1016/S2214-109X(20)30229-1.

Rollins NC, Bhandari N, Hajeebhoy N, Horton S, Lutter CK, Martines JC, Piwoz EG, Richter LM, Victora CG. 2016. Why invest, and what it will take to improve breastfeeding practices? *Lancet* 387(10017):491–504 DOI 10.1016/S0140-6736(15)01044-2.

Ronchi A, Pietrasanta C, Zavattoni M, Saruggia M, Schena F, Sinelli MT, Agosti M, Tzialla C, Varsalone FF, Testa L, Ballerini C, Ferrari S, Mangili G, Ventura ML, Perniciaro S, Spada E, Lunghi G, Piralla A, Baldanti F, Mosca F, Pugni L. 2021. Evaluation of rooming-in practice for neonates born to mothers with severe acute respiratory syndrome coronavirus 2 infection in Italy. *JAMA Pediatrics* 175(3):260–266 DOI 10.1001/jamapediatrics.2020.5086.

Salvatore CM, Han JY, Acker KP, Tiwari P, Jin J, Brandler M, Cangemi C, Gordon L, Parow A, Di Pace J, De La Mora P. 2020. Neonatal management and outcomes during the COVID-19 pandemic: an observation cohort study. *The Lancet Child & Adolescent Health* 4(10):721–727 DOI 10.1016/S2352-4642(20)30235-2.

Study Group on Revision of Support Guide for Breastfeeding and Weaning. 2019. A Professional Guide to Supporting Breastfeeding and Weaning, Revised FY 2019 [Jyunyuu Rinyuu No Shien Gaido-2019 Nenndo Kaiteiban]. Tokyo: Ministry of Health, Labour and Welfare.

The Johns Hopkins Coronavirus Resource Center. COVID-19 Dashboard, Mortality Analysis 2022. Available at https://coronavirus.jhu.edu/data/mortality (accessed on 13 March 2022).

Vazquez-Vazquez A, Dib S, Rougeaux E, Wells JC, Fewtrell MS. 2021. The impact of the Covid-19 lockdown on the experiences and feeding practices of new mothers in the UK: preliminary data from the COVID-19 new mum study. *Appetite* 156:104985 DOI 10.1016/j.appet.2020.104985.

von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative. 2007. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLOS Medicine* 4(10):e296 DOI 10.1371/journal.pmed.0040296.
Victora CG, Bahl R, Barros AJ, França GV, Horton S, Krasevec J, Murch S, Sankar MJ, Walker N, Rollins NC. 2016. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *Lancet* 387(10017):475–490 DOI 10.1016/S0140-6736(15)01024-7.

World Health Organization the United Nations Children’s Fund (UNICEF). 2021. Indicators for assessing infant and young child feeding practices: definitions and measurement methods. Geneva.

**World Health Organization. 1981.** *International code of marketing of breast-milk substitutes*. Geneva: World Health Organization, 1–24.

**World Health Organization. 2002.** *The optimal duration of exclusive breastfeeding, a systematic review*. Geneva: World Health Organization.

**World Health Organization. 2017.** Guideline: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services. Geneva.

**World Health Organization. 2020.** Marketing of breast-milk substitutes: national implementation of the international code, status report 2020. Geneva.

**World Health Organization, UNICEF. 2009.** Baby-Friendly Hospital Initiative-Revised, Updated, and Expanded for Integrated Care 2009. updated 23 November 2009. Available at https://www.unicef.org/documents/baby-friendly-hospital-initiative (accessed on 28 December 2011).

Zhu F, Zozaya C, Zhou Q, Castro CDe, Shah PS. 2021. SARS-CoV-2 genome and antibodies in breastmilk: a systematic review and meta-analysis. *Archives of Disease in Childhood - Fetal and Neonatal Edition* 106(5):514–521 DOI 10.1136/archdischild-2020-321074.