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# Relationship Between Maternal COVID-19 Infection and In-Hospital Exclusive Breastfeeding for Term Newborns

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## Keywords

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postpartum period

## ABSTRACT

**Objective:** To evaluate the relationship between maternal COVID-19 infection and the odds of in-hospital exclusive breastfeeding for term newborns.

**Design:** Retrospective descriptive quantitative.

**Setting:** A large, urban hospital with more than 6,000 births annually.

**Sample:** Term newborns born between March 1, 2020, and March 31, 2021 ( $N = 6,151$ ).

**Methods:** We retrospectively extracted data from electronic health records to evaluate the relationship of maternal COVID-19 infection with the odds of in-hospital exclusive breastfeeding using univariate analysis and logistic regression models. The covariates included insurance type, race/ethnicity, glucose gel administration, length of stay, newborn gestational age, newborn birth weight, and maternal COVID-19 infection.

**Results:** Maternal COVID-19 infection was not significantly related to the odds of in-hospital exclusive breastfeeding ( $p = .138$ ) after adjustment for covariates in the logistic regression model. However, when newborns who received pasteurized donor human milk supplementation were excluded from the logistic regression model, maternal COVID-19 infection significantly decreased the odds of in-hospital exclusive breastfeeding ( $p = .043$ ).

**Conclusion:** Maternal COVID-19 infection was not significantly related to the odds of in-hospital exclusive breastfeeding when newborns received donor human milk supplementation. Access to donor human milk for supplementation for term newborns may protect the odds of in-hospital exclusive breastfeeding.

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(Continued)

Guidelines to promote mother–newborn safety for in-hospital care after birth during the height of the COVID-19 pandemic were ever changing because of uncertainty about vertical and horizontal transmission of the virus and limited data regarding mother–newborn safety practices (American Academy of Pediatrics [AAP], 2021; Centers for Disease Control and Prevention, 2021; World Health Organization [WHO], 2020a). Consequentially, as experts sought to keep newborns safe between April 2, 2020, and July 22, 2020, the AAP advised temporarily separating mothers with COVID-19 from their newborns (AAP, 2020a, 2020b), despite recommendations from the WHO (2020c) to keep mothers and newborns together. The AAP

made this recommendation with knowledge of the risks and benefits of separating mothers and newborns and that separation could lead to newborn physiologic dysregulation (Ionio et al., 2021), maternal psychological distress, and decreases in breastfeeding rates (Bartick et al., 2021).

## Background

Many of the supportive breastfeeding practices recommended by the Baby-Friendly Hospital Initiative (BFHI; WHO, 2018) have been intermittently disallowed during the pandemic. For example, recommended skin-to-skin contact and direct breastfeeding were not possible when mother–newborn separation was required. This is

## Maternal COVID-19 infection could be related to decreased odds of in-hospital exclusive breastfeeding.

important because authors of a recent systematic review concluded that skin-to-skin holding regulates the newborn's autonomic nervous system, heart rate variability, cortisol, and oxytocin levels, showing the importance of skin-to-skin holding on stress regulation (Ionio et al., 2021).

Additionally, recommendations to only provide human milk became more challenging during mother–newborn separation. In a recent survey of hospital guidelines related to breastfeeding support during the COVID-19 pandemic across 124 hospitals in 22 nations in Europe during the COVID-19 pandemic, Merewood et al. (2021) found that 6% of hospitals encouraged mother–newborn separation, 6% recommended formula-feeding over breastfeeding for mothers with COVID-19, and 19% shortened the postpartum stay for all new mothers. Overall, 72% of hospitals used their national guidelines to guide policy changes (Merewood et al., 2021). In contrast, in a survey of postpartum practices in the United States from 318 hospitals in 46 states during the pandemic, Parker et al. (2022) found that 31% encouraged separation, 37% prohibited direct breastfeeding for mothers with COVID-19, and 59% encouraged early discharge for mothers without COVID-19. During the pandemic there was a call by leaders across the world to ensure access to donor human milk (DHM) in the absence of mother's milk (Shenker et al., 2020).

As breastfeeding policies in hospitals continue to change, the importance of breastfeeding remains the same. Exclusive breastfeeding during the first few days after birth is particularly important because colostrum contains essential bioactive and immune cells that are protective for the newborn (Cacho & Lawrence, 2017). Importantly, breastfeeding during maternal COVID-19 infection is protective to the newborn (Quitadamo et al., 2021). Furthermore, exclusive breastfeeding is also essential for optimal milk production and affects milk volume in the short and long term (Sriraman, 2017; Yu et al., 2019). Indeed, exclusive breastfeeding in the hospital after birth is a significant predictor of continued breastfeeding (Vehling et al., 2018). Therefore, hospital practices designed to support exclusive breastfeeding are critical.

The effect of changing practices regarding mother–newborn separation and visitor restrictions in hospitals after birth could reasonably alter a woman's plans for breastfeeding. Because separation may require supplementing expressed mother's milk with DHM or formula, we hypothesized that in-hospital exclusive breastfeeding rates would decline in the presence of maternal COVID-19 infection. Therefore, the objective of our study was to evaluate the relationship between maternal COVID-19 infection and the odds of in-hospital exclusive breastfeeding for term newborns born between March 2020 and March 2021.

## Methods

### Design

We used a retrospective descriptive quantitative design to determine the breastfeeding outcomes for mother–newborn dyads during the maternity hospital stay in the first year of the COVID-19 pandemic. The institutional review boards of the Baylor College of Medicine and The University of Texas Health Science Center at Houston granted human subjects approval. Both institutional review boards waived the requirement of informed consent.

### Setting

We conducted our study at a large academic women's and children's hospital in southeast Texas with more than 6,000 births per year. The facility was initially designated Baby-Friendly in 2016 and completed the redesignation survey in January 2022. Clinical staff members are trained on the practices required to achieve the BFHI 10 Steps for Successful Breastfeeding. Augmenting the support provided by nursing staff is a robust lactation and human milk laboratory department that offers lactation consultation from a nurse who is a board-certified lactation consultant and with peer breastfeeding counselors (24/7 coverage) for greater-acuity couplets in the mother–baby units, including mothers of newborns admitted to critical care units (e.g., neonatal and cardiovascular). The department also offers an outpatient breastfeeding clinic for in-person and e-health lactation consultation after hospital discharge. Milk laboratory services include technical support related to the storage, preparation, fortification, and delivery of mothers' own milk and DHM. Postbirth clinical practice includes skin-to-skin contact between the newborn and mother immediately after birth unless a maternal or postnatal medical reason delays this practice.

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**Table 1: Demographic and Descriptive Characteristics of Participants (N = 6,151)**

Characteristics	Values
<b>Maternal</b>	
COVID-19 infection	371 (6)
Insurance category, <i>n</i> (%)	
Self-pay	134 (2.1)
Medicaid	2,793 (45.4)
Private insurance	3,224 (52.4)
Race/ethnicity, <i>n</i> (%)	
White non-Hispanic	1,843 (29.9)
Hispanic	2,599 (42.2)
Black/African American	1,220 (19.8)
Asian	450 (7.3)
Other or unable to obtain	39 (0.5)
Length of stay, days, M (SD)	2.06 (0.6)
<b>Newborn</b>	
Sex, <i>n</i> (%)	
Male	3,165 (51.4)
Female	2,986 (48.5)
Glucose gel given, yes, <i>n</i> (%)	388 (6.3)
Feeding status during hospital stay, <i>n</i> (%)	
Exclusive human milk excluding DHM	2,461 (40)
Exclusive human milk including DHM	880 (14)
Human milk including formula	2,180 (35)
Exclusive formula	630 (10)
Gestational age at birth, weeks, M (SD)	39.18 (1.07)
Birth weight, kg, M (SD)	3.358 (0.445)

*Note.* Total percentages are not 100 on every characteristic because of rounding. DHM = donor human milk.

Skin-to-skin contact continues for at least 1 hour or until breastfeeding is initiated. If any reason necessitates mother–newborn separation, mothers are supported to express milk for their newborns. When supplementation is medically indicated for breastfed newborns in the mother–baby unit, mothers are given the option to use DHM rather than formula if their own expressed milk is not available. Donor human milk is provided at no cost to patients.

### Timeline

The first COVID-19 case in the community served by the hospital was reported on March

4, 2020. The hospital released its first COVID-19 preparation update on March 5, 2020. Visitor restrictions started on March 7, 2020, and continued throughout the study period. Between March 7, 2020, and April 2, 2020, the hospital continued to keep mothers and newborns together except in the case of severe COVID-19 infection coupled with the absence of a support person to care for the newborn. The hospital complied with the AAP (2020a, 2020b) recommendations to separate mothers with COVID-19 from their newborns from April 2, 2020, through July 22, 2020. We collected data from March 1, 2020, to March 31, 2021, to evaluate changes in practice and their relationships with in-hospital exclusive breastfeeding rates during the first 13 months of the pandemic.

### Sample

We included newborns born between March 1, 2020, and March 31, 2021, who were discharged from the mother–baby unit before 5 days after birth. Newborns were excluded if they were born at less than 37 completed weeks gestation, had a birth weight of 2.0 kg or less, were admitted to the NICU, or did not have a documented weight and gestational age (GA). We excluded newborns born at less than 37 weeks GA because they can have problems exclusively breastfeeding (Jónsdóttir et al., 2020) and are not included in The Joint Commission's (2012) reporting of exclusive breastfeeding status.

Of the 6,542 newborns born during the study's year, 6,151 met the inclusion criteria. We excluded 373 with a GAs of less than 37 weeks, 17 with lengths of stay (LOSs) of 5 days or longer, and one who did not have a documented GA and birth weight. We included twin newborns if they met the inclusion criteria. Forty sets of twins were included, and the feeding status of each twin was considered individually.

### Variables

We extracted newborn feeding status from the electronic health record based on the milk/feed type recorded by the nursing staff: breastfed, expressed mother's milk, colostrum, DHM, or formula. Exclusive breastfeeding was the dependent variable that we defined as receipt of only human milk, which included direct breastfeeding, expressed mother's milk, and DHM with the addition of vitamins or medications (WHO, 2008) such as glucose gel. We included

glucose gel administration as an indicator of hypoglycemia, which frequently involves the need for newborn diet supplementation and decreases exclusive breastfeeding rates (Kellams et al., 2017). We also included the following as variables: maternal COVID-19 status, newborn GA, weight at birth, newborn feeding during the hospital stay, receipt of glucose gel, LOS, race/ethnicity, and insurance type (i.e., self-pay, private, or Medicaid). Social determinants such as race/ethnicity and insurance type may be associated with breastfeeding rates (Centers for Disease Control and Prevention, 2019), so we included them as variables. We used insurance type as a marker of socioeconomic status, as described by Snyder and Chang (2020).

### Procedures

Data analysts at the study hospital extracted data from the electronic health record. The fourth author (N.H.) obtained and deidentified patient data from the secure database at the study site and securely shared them with the first author (J.G.) for analysis.

### Data Analysis

To evaluate potential covariates, we completed unadjusted univariate analyses for all variables to test for associations with exclusive breastfeeding. We used chi-square tests for categorical variables (maternal COVID-19 status, glucose gel administration, insurance type, and race/ethnicity) and *t* tests for independent samples for continuous variables (GA, birth weight, and LOS). We used JMP, version 16.0.0 (2021), for data analysis.

We included all variables that had significant univariate relationships with exclusive breastfeeding as covariates in the logistic regression models with exclusive breastfeeding as the dependent variable. The covariates included in each model were insurance type, race/ethnicity, glucose gel administration, LOS, newborn GA, newborn birth weight, and maternal COVID-19 status. Because the use of DHM in healthy term newborns is not common practice, we also used a logistic regression model that excluded the newborns who received DHM ( $n = 476$ ) from the exclusive breastfeeding group (Belfort et al., 2018; Sen et al., 2018). We also added an interaction term in the logistic regression model to evaluate the interaction between race/ethnicity and insurance status.

**Table 2: Univariate Analysis for Exclusive Breastfeeding**

Variable	Test Statistic ( <i>df</i> )	<i>p</i>
COVID-19 positive	$\chi^2 = 29.40$ (1)	<.0001
Glucose gel given: yes	$\chi^2 = 31.93$ (1)	<.0001
Insurance type: private/self-pay vs. Medicaid	$\chi^2 = 1,049$ (1)	<.0001
Race/ethnicity	$\chi^2 = 822.48$ (4)	<.0001
Gestational age	$t = 6.39$ (5,904)	<.0001
Birth weight	$t = 3.82$ (5,866)	.0001
Length of stay	$t = -11.82$ (5,826)	<.0001

## Results

### Demographics

Overall, the sample was racially and ethnically diverse: 29.9% White non-Hispanic, 42.2% Hispanic, 19.8% African American, and 7.3% Asian (see Table 1). Most mothers (52.4%) had private insurance, 45.4% had Medicaid, and 2.1% were self-paying. Additionally, 371 (6%) mothers tested positive for COVID-19 and had a mean LOS of 2.06 days ( $SD = 0.6$ ).

Newborn feeding status was documented as exclusive breastfeeding in 54% of dyads. Of the newborns exclusively breastfed, 14% received DHM supplementation. The newborns had a mean GA of 39.18 weeks (range = 37 0/7 to 42 4/7 weeks) and a mean birth weight of 3.358 kg (range = 2.03–5.679 kg).

### Relationship of COVID-19 Infection With Exclusive Breastfeeding

All variables were significantly related to the outcome of exclusive breastfeeding before adjustment in the logistic regression model (see Table 2). In the unadjusted univariate analysis, mothers who tested positive for COVID-19 were 45% less likely to exclusively breastfeed ( $OR = 0.55$ , 95% confidence interval [CI] [0.45, 0.68],  $p < .0001$ ), and mothers were 45% less likely to exclusively breastfeed if their newborns received glucose gel ( $OR = 0.55$ , 95% CI [0.44, 0.67],  $p <$

.0001). Mothers with private insurance were 5.7 times ( $OR = 5.68$ , 95% CI [5.09, 6.34],  $p < .0001$ ) more likely to exclusively breastfeed than those with Medicaid. Overall, mothers with COVID-19 infection ( $n = 371$ ) exclusively breastfed at a lower rate (40.7%) than mothers without COVID-19 (55.1%) before hospital discharge ( $p < .0001$ ). The interaction term between race/ethnicity and insurance status was not significant ( $p = .11$ ) and not included in the final model.

We estimated the first logistic regression model for exclusive, in-hospital breastfeeding and adjusted for insurance type, race/ethnicity, glucose gel administration, LOS, newborn GA, newborn birth weight, and maternal COVID-19 status. The ORs, CIs, and  $p$  values for each predictor are displayed in Table 3. The overall model tested had  $R^2 = 0.169$ ,  $\chi^2(10, N = 6,151) = 1,424.26$ , and  $p < .0001$ . Glucose gel administration ( $p < .0001$ ), Medicaid ( $p < .0001$ ), GA ( $p < .0001$ ), LOS ( $p < .0001$ ), and African American race (vs. White,  $p < .0001$ ) significantly lowered the odds of in-hospital exclusive breastfeeding. Maternal COVID-19 infection ( $p = .138$ ) and birth weight ( $p = .111$ ) were not significantly associated with the likelihood of in-hospital exclusive breastfeeding.

### Relationships of Other Variables With Exclusive Breastfeeding

We estimated a second logistic regression model for exclusive breastfeeding, not including those

## The use of pasteurized donor human milk for supplementation may protect the odds of in-hospital exclusive breastfeeding despite maternal COVID-19 infection.

receiving DHM, and adjusted for insurance type, race/ethnicity, glucose gel administration, LOS, newborn GA, newborn birth weight, and maternal COVID-19 status (see Table 4). The overall model explained a small but significant amount of variance in exclusive breastfeeding,  $R^2 = 0.155$ ,  $\chi^2(10, N = 2,461) = 1,282.87$ ,  $p < .0001$ . Glucose gel administration ( $p < .0001$ ), Medicaid ( $p < .0001$ ), GA ( $p < .0001$ ), African American race (vs. White,  $p < .0001$ ), and LOS ( $p < .0001$ ) were significantly associated with decreased odds of in-hospital exclusive breastfeeding. Maternal COVID-19 infection was significantly associated with decreased odds of in-hospital exclusive breastfeeding ( $p = .043$ ) in this model when those receiving DHM were excluded from the sample (see Figure 1).

### Discussion

Our findings suggest that DHM supplementation for term newborns may protect the odds of in-hospital exclusive breastfeeding during the COVID-19 pandemic. Our findings show that mothers with COVID-19 infection exclusively breastfed at a lower rate than healthy mothers (40.7% vs. 55.1%), although this difference was not statistically significant after adjustment for confounders in the logistic regression model. In the second logistic regression model in which we removed newborns who received DHM from the exclusively breastfed sample, we found that COVID-19 infection significantly decreased the odds of in-hospital exclusive breastfeeding, suggesting that DHM increased the odds of in-hospital exclusive breastfeeding.

Previous researchers showed that exclusive breastfeeding rates in women without COVID infection decreased during the COVID-19 lockdown (Latorre et al., 2021; Zanardo et al., 2021). Additionally, in an observational longitudinal cohort study of 85 mothers who were positive for COVID-19, Popofsky et al. (2020) found that separation of mother and newborn during the pandemic significantly decreased exclusive in-hospital breastfeeding rates ( $p < .001$ ), which supports the downtrend in breastfeeding rates during the AAP-recommended separation noted in Figure 1. Furthermore, Marín Gabriel et al.

**Table 3: Summary of Logistic Regression Analysis for Predicting Exclusive Breastfeeding.**

Variable	OR	95% CI	$p$
COVID-19	0.83 (positive)	[0.66, 1.06]	.138
Glucose gel	0.52 (yes)	[0.41, 0.67]	<.0001
Insurance type: Medicaid	0.26 (vs. private insurance)	[0.22, 0.29]	<.0001
Race: African American	0.29 (vs. White, non-Hispanic)	[0.25, 0.36]	<.0001
Gestational age, weeks	1.12	[1.06, 1.19]	<.0001
Birth weight, g	0.99	[0.99, 1.00]	.111
Length of stay, days	0.62	[0.56, 0.68]	<.0001

Note. CI = confidence interval.



### Improving access to pasteurized donor human milk for supplementation of term newborns may help maintain in-hospital exclusive breastfeeding when mother–newborn separation is necessary.

(2021) found that BFHI sites maintained greater exclusive breastfeeding rates at hospital discharge than non-BFHI hospitals during the pandemic.

The AAP currently recommends that breastfeeding continue with precautions in the presence of maternal COVID-19 infection (American Academy of Pediatrics, 2021). Because breastfeeding disruptions can negatively affect newborn survival (Busch-Hallen et al., 2020), the Global Breastfeeding Collective has highlighted the need for continued support to protect breastfeeding during the pandemic (WHO, 2020d). In instances of maternal–newborn separation and insufficient expressed mother's milk, our findings suggest that access to DHM for term newborns significantly increased the odds of exclusive breastfeeding during the in-hospital postpartum period.

Although the practice of offering DHM when a mother's milk is insufficient or unavailable is supported by the WHO (2020b), DHM use for in-hospital supplementation of term newborns is not common practice, most likely because of lack of insurance coverage, cost, and availability (Belfort et al., 2018). Additionally, mothers may not know enough about DHM to request its use to supplement their newborns while in the hospital (Rabinowitz et al., 2018). In another study, women who were not White were less likely to choose DHM over formula ( $n = 678$ ; White vs. Hispanic:  $OR = 0.28$ , 95% CI [0.12, 0.65]; White vs. Black:  $OR = 0.32$ , 95% CI [0.13, 0.76]), which may further increase racial disparities for exclusive breastfeeding (Kair et al., 2020). Additionally, we are concerned that patients in our accountable care organization may not have received information about the importance of exclusive breastfeeding and the availability of DHM. Possible unconscious bias related to insurance coverage or ethnicity needs to be explored related to the use of DHM and the promotion of exclusive breastfeeding.

Previous researchers found that DHM given as part of a nurse-led hypoglycemia algorithm during the in-hospital postpartum period provided an

effective supplement for hypoglycemic newborns of breastfeeding mothers and decreased NICU admissions from 16% to 6% after implementation (Ponnapakkam et al., 2021). Additionally, Merjaneh et al. (2020) found that newborns supplemented with DHM instead of formula were five times more likely to be exclusively breastfed at 6 months of age. Our findings provide further evidence to support the use of DHM to ensure that in-hospital exclusive breastfeeding rates are not affected during unforeseen circumstances such as the pandemic or other maternal or newborn illnesses that necessitate the separation of mothers and their newborns.

#### Implications for Practice and Policy

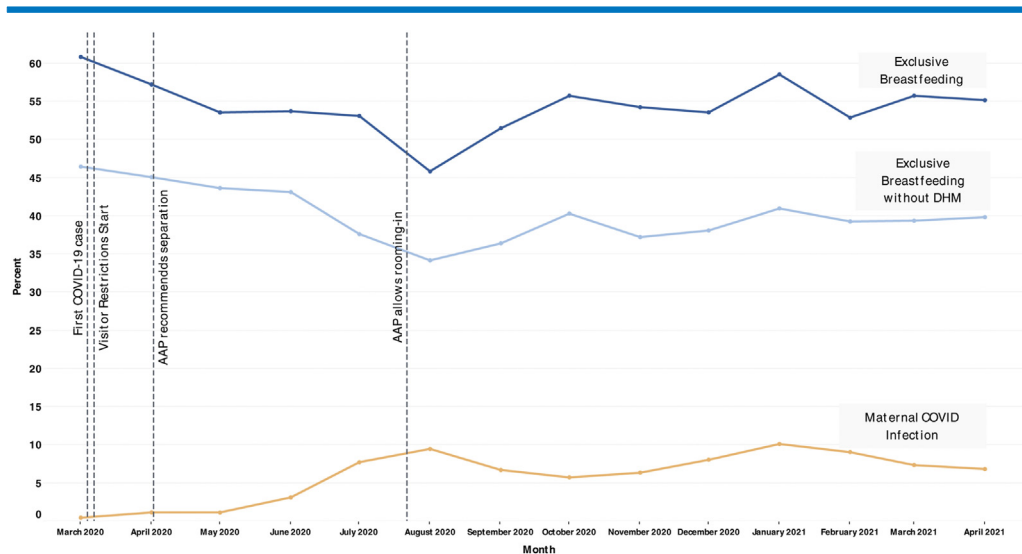
Supplementation with DHM for term newborns as a bridge to the mother's milk supply may be appropriate alongside continued lactation support. Additionally, a unit policy to guide the use of DHM is essential. A comprehensive DHM policy should include parent and staff education on eligibility, safety, and the use of DHM and information on ordering and handling DHM (Drouin et al., 2019). In addition, staff education must include information about support for populations less likely to choose DHM for supplementation (Kair et al., 2020).

Only 15 state Medicaid programs cover the use of DHM, and the stipulations for use often require a medical prescription (Shah & Miller, 2022). Additionally, as of 2019, Medicaid covered 42.1% of all women giving birth in the United

**Table 4: Summary of Logistic Regression Analysis for Predicting Exclusive Breastfeeding Excluding Donor Human Milk**

Variable	OR	95% CI	<i>p</i>
COVID-19	0.77 (positive)	[0.59, 0.99]	.043
Glucose gel	0.25 (given)	[0.18, 0.34]	<.0001
Insurance type	0.36 (Medicaid)	[0.32, 0.42]	<.0001
Race: African American	0.41 (vs. White, non-Hispanic)	[0.34, 0.49]	<.0001
Gestational age, weeks	1.13	[1.06, 1.20]	<.0001
Birth weight, g	0.999	[0.99, 1.00]	.71
Length of stay, days	0.36	[0.32, 0.40]	<.0001

Note. CI = confidence interval.



**Figure 1.** Timeline of exclusive breastfeeding, maternal COVID-19 infection rates, and COVID-related policies. AAP = American Academy of Pediatrics; DHM = donor human milk.

States. Among these women, 59% identified as Hispanic, and 65.1% identified as non-Hispanic Black (Martin et al., 2021). Furthermore, hospitals with greater than 75% Medicaid patients were less likely to offer DHM (Parker et al., 2020); therefore, women of color have lower access to DHM. For this reason, when supporting legislation regarding DHM coverage, Medicaid reform is needed to lessen racial disparities related to the receipt of human milk.

### Limitations

Our results are limited by the retrospective, observational, nonrandomized design of the study. Because we conducted our study from a single site in the southern United States with a high level of breastfeeding support, the results may not represent or be applicable to other sites. Our results could have been affected by known confounding variables not reliably extractable from the electronic health record, such as visitor restrictions, mother–newborn separation time (Popofsky et al., 2020), maternal body mass index (D’Souza et al., 2019), maternal education, maternal nicotine use, or breastfeeding intent (Cohen et al., 2018; Xiang et al., 2019). In addition, our results could have been affected by known confounding variables, such as maternal age and mode of birth, that were not available in the data set at the time of analysis and have been associated with breastfeeding outcomes (Cohen et al., 2018;

Xiang et al., 2019). Finally, there may be unknown confounders that could have affected the results.

### Conclusion

Maternal COVID-19 infection was not significantly associated with the exclusive breastfeeding rate in the study hospital. However, when DHM supplementation was unavailable, we found a small but significant decrease in the odds of in-hospital exclusive breastfeeding in the presence of maternal COVID-19 infection. Although this finding suggests the importance of the availability of DHM for supplementation in healthy term newborns, further studies are needed to understand the benefits and costs of DHM supplementation when medically necessary for healthy term newborns. Also, studies evaluating the effects of uncertainty and lack of family support, as with the COVID-19 pandemic and visitor restrictions, are needed to determine their influence on breastfeeding intent and breastfeeding self-efficacy to better support mothers in their breastfeeding journeys. Overall, our results suggest that having DHM available for medically necessary supplementation is associated with improved in-hospital, exclusive breastfeeding rates.

### CONFLICT OF INTEREST

The authors report no conflicts of interest or relevant financial relationships.



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None.



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