


Impact of the coronavirus disease 2019 pandemic on breastfeeding during and at discharge from neonatal care: An observational cohort study

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ABSTRACT

Importance: During the coronavirus disease 2019 (COVID-19) lockdown, changes in the visiting rules in neonatal units might have affected the initiation and continuation of breastfeeding.

Objective: To investigate the effects of the implementation of the COVID-19 lockdown in the UK on mother's own milk (MOM) feeding in hospital and at the time of discharge in two UK neonatal units.

Methods: Retrospective cohort study using routinely recorded data from electronic patient records. Data were retrieved from two neonatal services in the UK East Midlands region. Adjusted logistic regression was used to compare the odds of MOM feeding before, and after the implementation of the UK lockdown.

Results: Among 2073 infants, after adjusting for maternal and infant characteristics and underlying trends over time, there were no differences in the odds of infants receiving any MOM during admission; any MOM at discharge or exclusive MOM at discharge before and after the imposition of the lockdown. Infants with birthweight <1000 g were three times less likely to receive any MOM at discharge compared to those with birthweight >2500 g (adjusted odds ratio [OR] 0.33, 95% confidence interval [CI]: 0.22–0.50). Younger mothers were less likely, and Black British mothers more likely, to be feeding MOM to their infants at discharge, while women in the least deprived Index of Multiple Deprivation (IMD) quintiles were 2–4 times more likely to do so, compared to those in the most deprived IMD quintile (adjusted OR 2.78, 95% CI: 1.97–3.90).

Interpretation: Despite the difficulties faced during COVID-19 pandemic-induced restrictions, infants in the participating neonatal units continued to receive MOM in similar proportions as before the pandemic.

KEYWORDS

Breastfeeding, COVID-19, Infant, Newborn

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INTRODUCTION

In England, 75% of all infants initiate breastfeeding but only 45% receive any breastmilk at 6–8 weeks of age.¹ The UK National Neonatal Audit Programme reports the proportion of preterm infants born at <33 completed weeks' gestation fed any mother's own milk (MOM) at the time of discharge from neonatal care. In 2020, it was reported that this has remained persistently low over 5 years, with a marked geographical variation.² Policies to protect, support, and promote breastfeeding should be integral in all neonatal services. Being close to their infants, the opportunity to have skin-to-skin care and support from trained healthcare professionals assist mothers in providing their own milk to their infants.³

Despite the minimal direct health impact of severe acute respiratory syndrome coronavirus 2 infection on infants, the coronavirus disease 2019 (COVID-19) pandemic has significantly affected in-hospital newborn care due to the implementation of visiting restrictions.⁴ In the UK, a national lockdown was implemented on March 23, 2020.⁵ Although the restrictions varied widely and policies were changed frequently and rapidly during the following months, parents of infants on neonatal units reported that their ability to visit, care for and bond with their infant was adversely affected.⁴

For example, in the study units, before the pandemic, all the mothers/parents were allowed unlimited access to visit and were able to feed their babies throughout the day. Direct breastfeeding is encouraged and there is support provided in the unit by the nurses and lactation nurses, if needed. For infants who were on tube feeding or bottle feeding, expressed breast milk is the preferred milk and is usually provided and sent by mothers to the neonatal unit and is stored in the unit and warmed at the feeding times.

After the start of the lockdown on March 23, 2020, only one of the parents was allowed to visit their babies once a day. Either one of them was able to choose to stay all day or for a short period of time, but there should be no swapping or return on the same day. Rooming-in and breastfeeding were allowed as usual. Mothers who are suspected or confirmed to have COVID-19 will not be able to go onto the unit until they have tested negative or until 10 days after the onset of their symptoms, but they can continue sending expressed breast milk to the unit. If mothers/parents have any symptoms of COVID-19, they should self-isolate for 10 days following National Health Service (NHS) guidelines and not come to the neonatal unit until a negative test has been confirmed and they are symptom-free. The visitation policy was gradually eased around August 2020 when there was unrestricted access to mothers, but partners can visit once a day for any duration.

In this study, we aimed to investigate if the imposition of the national lockdown, and associated restrictions, on 23 March 2020 in the UK affected MOM feeding in hospitals and at the time of discharge among infants admitted to two neonatal units in the UK.

METHODS

Ethical approval

The datasets were created as part of routine clinical care of infants at the participating units. Data were accessed and analyses were performed with approval of both NHS Trusts (University Hospitals of Derby and Burton NHS Foundation Trust, Audit approval number UHDBW69) and the Nottingham University Hospitals NHS Trust. This study did not include any identifiable patient information and only data that were routinely collected were used. No informed consent was sought for participation.

Study setting and data source

We used data from two neonatal services in the UK East Midlands region: a Level 2 Local Neonatal Unit which cares for infants born >25 weeks' gestational age and a Level 3 Neonatal Intensive Care Unit which delivers care, over two hospital sites, to infants born at all gestations and provides tertiary surgical care. We used data from infants' medical records entered at the point of care into a data management system (Badger.net, Clevermed Ltd).

Study population

Data were included from infants admitted from January 01, 2017 to December 31, 2020. Infants were excluded if they were missing data on key demographic characteristics, were admitted >72 h after birth, stayed on the unit for <72 h, or died or were transferred out to another neonatal unit for continuing neonatal or specialist care.

Statistical methods

Demographic and clinical characteristics of the infants and their mothers were first described, using counts and percentages, mean \pm standard deviation or median (interquartile range), as appropriate. We then plotted graphically the percentage of infants by month of admission who were recorded as having each of three outcomes: a) received any MOM during admission in the neonatal unit from enteral nutrition (expressed breast milk/direct breastfeeding); b) were receiving any MOM at discharge from enteral nutrition (expressed breast milk/direct breastfeeding); c) were being exclusively fed MOM at discharge from enteral nutrition (expressed breast milk/direct breastfeeding). For breast milk feeding practices, the term 'breastfeeding' that will be discussed in this section is defined as any

TABLE 1 Characteristics of included infants

Characteristics	Admissions before lockdown (n = 1686)	Admissions after lockdown (n = 387)	P
Admissions per month	43 (38–47)	43 (34–45)	0.332
Gestational age at birth (completed weeks)	34 (31–37)	33 (32–36)	0.834
Gestational age at birth (categorized, weeks)			0.346
≥37	447 (26.5)	96 (24.8)	
32–36	795 (47.2)	199 (51.4)	
28–31	330 (19.6)	73 (18.9)	
<28	114 (6.8)	19 (4.9)	
Female	678 (40.2)	170 (43.9)	0.180
Birthweight (g)	2094 (1535–2860)	2050 (1607–2880)	0.608
Birthweight (categorized, g)			0.345
≥2500	586 (34.8)	133 (34.3)	
1500–2499	705 (41.8)	175 (45.2)	
1000–1499	280 (16.6)	61 (15.8)	
<1000	115 (6.8)	18 (4.7)	
Birthweight for age z-score	−0.13 ± 1.18	−0.01 ± 1.22	0.080
Small for gestational age	268 (15.9)	55 (14.2)	0.410
Multiple birth	304 (18.0)	60 (15.5)	0.239
Discharge destination			0.005
Home	1172 (69.5)	297 (76.7)	
Ward	514 (30.5)	90 (23.3)	
Length of stay (days)	14 (6–30)	15 (7–28)	0.719
Gestational age at discharge (completed weeks)	37 (35–39)	37 (35–39)	0.659
Number of days ventilated	0 (0–2)	0 (0–2)	0.934
Ventilated for >3 days	239 (14.2)	54 (14.0)	0.910
Number of days of parenteral nutrition	0 (0–5)	0 (0–4)	0.505
Received parenteral nutrition for >2 weeks	116 (6.9)	32 (8.3)	0.339
One or more morbidities	444 (26.3)	98 (25.3)	0.683
Patent ductus arteriosus	198 (11.7)	34 (8.8)	0.096
Hypoxic ischaemic encephalopathy grade 2/3	42 (2.5)	8 (2.1)	0.624
Intraventricular haemorrhage grade 3 or 4	26 (1.5)	2 (0.5)	0.115
Periventricular leukomalacia	14 (0.8)	3 (0.8)	0.914
Necrotising enterocolitis	26 (1.5)	10 (2.6)	0.157
Chronic lung disease	144 (8.5)	26 (6.7)	0.239
Sepsis	86 (5.1)	22 (5.7)	0.641
Major congenital anomaly	66 (3.9)	17 (4.4)	0.665

Data were presented as median (interquartile range), *n* (%) or mean ± standard deviation. Before lockdown: from January 01, 2017 to March 22, 2020, after lockdown: from March 23, 2020 to December 31, 2020.

administration of breast milk (MOM) by any method of enteral or oral feeding i.e. direct breastfeeding, or alternatives, such as cup, bottle or syringe, or by nasogastric tube. There was no record of the use of donor breast milk in these cohorts.

We used logistic regression to model the odds of the three outcomes for infants admitted during the COVID-19 pandemic (defined as an admission on or after March 23, 2020, the date lockdown was implemented in the UK relative to admission beforehand). We first calculated unadjusted odds

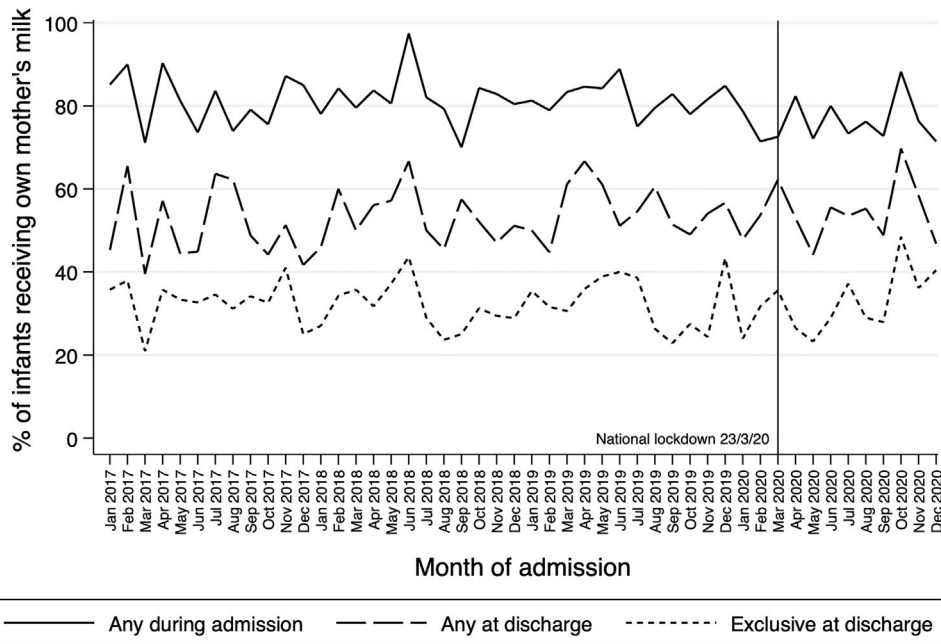


FIGURE 1 Percentage of infants who received their mother's own milk during and at discharge from neonatal care.

ratios (ORs), then adjusted in a stepwise manner for any underlying trend over time, and infant and maternal characteristics. Odds ratios are presented with 95% confidence intervals (CIs) and *P*-values; we used robust standard errors to account for the clustering of infants by mother and by unit.

We also used multivariable logistic regression to explore the characteristics of infants who were discharged from neonatal care receiving any MOM compared to those who were not receiving any MOM at discharge. We first calculated unadjusted odds ratios for the association between infant and maternal characteristics and the outcome variable. Variables that were associated at the univariable level ($P < 0.1$, chosen to reflect the exploratory nature of the analysis) were entered into a multivariable model, and backward regression was used to build a final, parsimonious model. We checked for collinearity between variables and again accounted for clustering by mother and unit.

All data management and analysis were carried out in Stata (version 17; StataCorp, College Station, TX, USA). Data from the two neonatal services were combined for analysis to increase study power and preserve anonymity.

RESULTS

From the population of infants cared for in the participating neonatal units during the study period, 2073 infants were retained after exclusions. Of these, 1686 infants were admitted before (from January 01, 2017 to March 22, 2020)

and 387 were admitted after the lockdown was implemented (from March 23, 2020 to Dec 31, 2020). There were no significant differences in the infant or maternal characteristics between the infants who were admitted during the two periods, except for discharge destination and mode of delivery (Tables 1 and S1).

A total of 1656 (79.9%) of the total infants admitted during the study period received any MOM in the neonatal unit; 1051 (50.7%) were receiving some MOM at discharge and 640 (30.9%) were exclusively MOM fed at discharge. Figure 1 shows the percentage of infants admitted who received MOM by month of admission during the study period. There were no differences in the odds of infants receiving any MOM in the neonatal units, at discharge, and being exclusively MOM fed at discharge before, and after, the lockdown was implemented when adjusted in a stepwise manner for any underlying trend over time, and infant and maternal characteristics (Table S2).

In further exploratory analyses, we assessed which infant and maternal characteristics were associated with an infant receiving any MOM at discharge (Table 2). The odds of receiving any MOM at discharge were significantly lower among infants born extremely preterm, those with birthweight < 1000 g, and those who were multiple births when compared to term infants, those with normal birthweight, and singletons, respectively. After adjusting for confounders, infants with birthweight < 1000 g were 3-times less likely to receive any MOM at discharge compared to those with birthweight ≥ 2500 g (adjusted OR

TABLE 2 Infant and maternal characteristics associated with the infant receiving mother’s own milk at discharge

Variables	Number of participants	Receiving any mother’s own milk at discharge, <i>n</i> (%)	Unadjusted OR (95% CI)	<i>P</i>	Adjusted OR (95% CI)	<i>P</i>
Characteristics of infants (<i>n</i> = 1983)						
Gestational age at birth (weeks)				0.006	–	–
≥37	503	298 (59.3)	Ref			
32–36	963	494 (51.3)	0.72 (0.58–0.90)			
28–31	386	200 (51.8)	0.74 (0.57–0.97)			
<28	131	59 (45.0)	0.56 (0.38–0.83)			
Sex				0.579	–	–
Male	1164	623 (53.5)	Ref			
Female	819	428 (52.3)	0.95 (0.79–1.14)			
Birthweight (g)				0.002		<0.001
≥2500	676	385 (57.0)	Ref		Ref	
1500–2499	853	448 (52.5)	0.84 (0.68–1.02)		0.97 (0.77–1.23)	
1000–1499	323	167 (51.7)	0.81 (0.62–1.06)		0.86 (0.62–1.19)	
<1000	131	51 (38.9)	0.48 (0.33–0.71)		0.33 (0.22–0.50)	
Small for gestational age (<10th centile for birthweight)				0.311	–	–
No	1679	898 (53.5)	Ref			
Yes	304	153 (50.3)	0.88 (0.69–1.13)			
Multiple births				0.016		0.021
No	1631	885 (54.3)	Ref		Ref	
Yes	352	166 (47.2)	0.75 (0.60–0.95)		0.72 (0.55–0.95)	
Length of stay (day)				0.024	–	–
3–6	484	264 (54.6)	Ref			
7–13	445	250 (56.2)	1.07 (0.82–1.38)			
14–29	550	299 (54.4)	0.99 (0.78–1.29)			
≥30	504	238 (47.2)	0.75 (0.58–0.96)			
One or more morbidities				0.462	–	–
No	1457	765 (52.5)	Ref			
Yes	526	286 (54.4)	1.08 (0.88–1.32)			
Characteristics of mothers (<i>n</i> = 1848)						
Age of the mother at delivery (year)				<0.001		<0.001
16–19	28	7 (25.0)	0.29 (0.12–0.70)		0.32 (0.13–0.78)	
20–24	105	35 (33.3)	0.49 (0.31–0.77)		0.53 (0.32–0.89)	
25–29	184	92 (50.0)	0.90 (0.62–1.30)		1.07 (0.72–1.60)	
30–34	229	114 (49.8)	Ref		Ref	
35–39	119	65 (54.6)	1.17 (0.76–1.78)		1.20 (0.75–1.92)	
≥40	38	22 (57.9)	1.41 (0.72–2.76)		1.37 (0.68–2.77)	
Missing	1145	656 (57.3)	1.32 (1.00–1.74)		1.48 (1.08–2.03)	
Ethnic group				0.003		0.041
White	1220	615 (50.4)	Ref		Ref	
Mixed	52	29 (55.8)	1.07 (0.63–1.81)		1.13 (0.63–2.03)	
Asian/Asian British	161	91 (56.5)	1.23 (0.90–1.70)		1.28 (0.88–1.86)	

(Continues)

TABLE 2 (Continued)

Variables	Number of participants	Receiving any mother's own milk at discharge, <i>n</i> (%)	Unadjusted OR (95% CI)	<i>P</i>	Adjusted OR (95% CI)	<i>P</i>
Black/Black British	66	41 (62.1)	1.88 (1.14–3.09)		1.96 (1.16–3.31)	
Other	44	29 (65.9)	1.87 (1.01–3.47)		1.81 (0.91–3.60)	
Missing	305	186 (61.0)	1.49 (1.16–1.91)		1.34 (1.00–1.78)	
First language English				0.640	–	–
Yes	1742	934 (53.6)	Ref			
No	106	57 (53.8)	1.09 (0.75–1.59)			
Index of multiple deprivation quintile				<0.001		<0.001
1 (most deprived)	608	249 (41.0)	Ref		Ref	
2	312	171 (54.8)	1.63 (1.25–2.13)		1.78 (1.31–2.43)	
3	280	153 (54.6)	1.77 (1.34–2.33)		1.88 (1.37–2.57)	
4	222	142 (64.0)	2.60 (1.92–3.51)		2.74 (1.94–3.87)	
5 (least deprived)	248	170 (68.6)	3.06 (2.26–4.13)		2.78 (1.97–3.90)	
Missing	178	106 (59.6)	2.16 (1.54–3.01)		2.59 (1.78–3.77)	
One or more previous pregnancies				<0.001		0.025
Yes	1011	500 (49.5)	Ref		Ref	
No	789	465 (58.9)	1.53 (1.28–1.84)		1.34 (1.09–1.66)	
Missing	48	26 (54.2)	1.38 (0.80–2.39)		1.19 (0.64–2.22)	
Mode of delivery				0.242	–	–
Vaginal	717	400 (55.8)	Ref			
Caesarean section	952	503 (52.8)	0.90 (0.74–1.08)			
Missing	179	88 (49.2)	0.77 (0.56–1.07)			
Mother's intention to breastfeed before delivery				<0.001		<0.001
Yes	1094	738 (67.5)	Ref		Ref	
No	351	51 (14.5)	0.09 (0.06–0.12)		0.09 (0.06–0.12)	
Missing	403	202 (50.1)	0.45(0.39–0.61)		0.57 (0.44–0.74)	

–, not applicable. Abbreviations: CI, confidence interval; OR, odds ratio.

0.33, 95% CI: 0.22–0.50). As expected, younger mothers (as compared to 30–34-year-old mothers) were less likely, and Black or Black British mothers (as compared to white ethnicity) were more likely to be feeding MOM at discharge. Similarly, women in the least deprived quintile of the Index of Multiple Deprivation (IMD) were 2–4 times more likely to breastfeed compared to those in the most deprived quintile (adjusted OR 2.78, 95% CI: 1.97–3.90).

DISCUSSION

Despite the national lockdown, there were no significant changes in the odds of infants receiving MOM in hospital and at discharge in the participating neonatal units. After adjusting for any underlying trends over time, and accounting for infant and maternal characteristics, there were no differences in the odds of infants receiving MOM in hospital, or those receiving any or exclusive MOM at discharge,

between the period before, and after, the implementation of the national lockdown.

Contrary to the present findings, in an analysis of admissions to UK neonatal units from 2012 to 2020, Greenbury et al.⁶ reported that, during the COVID-19 period, breastfeeding at discharge decreased among moderate-to-late preterm infants and rose among full-term infants, but there were no changes among extremely and very preterm infants.

However, a survey of parents of infants admitted to six neonatal units in the UK and USA⁴ found that 56% felt that pandemic restrictions had not affected their ability to visit their infant, although most reported that visits from their partners, and the baby's grandparents and siblings, were reduced. However, in the same study, 12% reported a severe impact on breastfeeding although a larger number (25%)

reported that breastfeeding was only mildly impacted.⁴ Similarly, another survey in Tripoli, Libya, reported a larger impact with 14/41 (34%) respondents saying that they were unable to properly breastfeed and a quarter reported severe effects on breastfeeding due to visitation policy.⁷ A comparison of 210 mother-infant dyads in Italy during their lockdown period with 306 matched dyads from 2018 also found that exclusive breastfeeding was lower at hospital discharge in lockdown compared to 2018 (70% vs. 98%), at 30 days (54% vs. 76%) and 90 days (32% vs. 71%). This effect was attributed to the isolation from family and friends.⁸

There are several factors that might be contributing to no changes in the proportion of breastfeeding in our units as compared to before the lockdown. Based on the early COVID-19 visiting policy in the neonatal units involved, mothers (or one of the parents) could only visit once a day which means that they may choose to stay all day or for a short period. This indicates that mothers still had a chance to breastfeed their infants as long or as frequently as they could during the stay if they would like to, which possibly explains the unaffected prevalence of any breastfeeding recorded during admission during this period.

Furthermore, in these hospitals, the practice of skin-to-skin contact with mothers in the first hour of life was not altered during the pandemic. Even among mothers who were COVID-19 positive, skin-to-skin care and initiation of breastfeeding in the delivery room were practiced with some precautions taken as per WHO recommendations.⁹ All mothers were allowed to breastfeed their infants while in the hospital (maternity ward or neonatal unit). This is also supported by studies that have shown that rooming in with the mother and breastfeeding are the safe and perinatal transmission of COVID-19 infection to infants from infected mothers are very rarely happens if close attention to infection prevention and control is practised.¹⁰

Apart from the impacts on breastfeeding, we also investigated the association between infant and maternal characteristics that affect MOM feeding and found, as expected, that women in the least deprived quintile were significantly more likely to breastfeed compared to those in the most deprived quintile. This is in keeping with our previous regional reports¹¹ and larger national studies.¹² Oakley et al. reported that, outside of London, women in the most deprived quintiles had 21%–32% reduced odds of breastfeeding compared to women in the least deprived areas.¹²

We also found that the smallest and most premature infants, and those who had lengths of hospital stay longer than 30 days, had the lowest odds of receiving any MOM at discharge. This could be due to the less stable medical con-

ditions among these most premature infants which could have caused them to need extra support in terms of both nutrition and medical needs. This is also consistent with studies that showed that infants with morbidities and born at lower gestational age had a lower likelihood of receiving any breast milk at discharge^{13,14} and was regarded as a barrier to breastfeeding from the mothers' perspective.³ Continued support for mothers to assist milk expression sustained over long hospital stays, and facilities to establish feeding on the breast before discharge, may improve the rates of MOM feeding in this most vulnerable population.

Although there was a lack of clear guidance initially before many neonatal units were compelled to impose strict visiting restrictions, local neonatal teams supported by professional organizations such as the Royal College of Paediatrics and Child Health and the British Association of Perinatal Medicine, as well as parent-led organizations such as Bliss baby charity, worked to ensure that parental visits were re-instated, with emphasis that “parents are not visitors” and “parental restrictions should be exercised only when absolutely necessary”.¹⁵ The visiting policies in both participating services were affected by the national lockdown but were rapidly adapted to help parents spend time with their infants. This supported breastfeeding mothers to continue to provide their own milk to their infants and could have mitigated the effects of the implementation of lockdown restrictions on the proportion of infants who received MOM.

In conclusion, despite the difficulties faced due to COVID-19 pandemic-induced restrictions, infants in the neonatal units included in this study continued to receive MOM in similar proportions as before the pandemic. This could be attributed to the unaltered breastfeeding policy in the study units that were implemented as recommended by the WHO. However, continued vigilance and advocacy are required to ensure that we are prepared to safeguard the interests of newborn infants in the event of any future contingencies.

CONFLICT OF INTEREST

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SUPPORTING INFORMATION

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