The impact of neonatal unit policies on breast milk feeding at discharge of moderate preterm infants: The EIPAGE-2 cohort study

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Abstract

Facilitating factors and barriers to breast milk feeding (BMF) for preterm infants have been mainly studied in very preterm populations, but little is known about moderate preterm infants. We aimed to analyze hospital unit characteristics and BMF policies associated with BMF at discharge for infants born at 32 to 34 weeks' gestation. EIPAGE-2, a French national cohort of preterm births, included 883 infants born at 32 to 34 weeks' gestation. We investigated kangaroo care in the first 24 hr, early involvement of parents in feeding support, volume of the unit, BMF information given to mothers hospitalized for threatened preterm delivery, protocols for BMF, presence of a professional trained in human lactation, unit training in neurodevelopmental care, and regional BMF initiation rates in the general population. Multilevel logistic regression analysis was used to investigate associations between unit policies and BMF at discharge, adjusted for individual characteristics and estimating odds ratios (ORs) and 95% confidence intervals (CIs). Overall, 59% (490/828) of infants received BMF at discharge (27% to 87% between units). Rates of BMF at discharge were higher with kangaroo care (adjusted OR 2.03 [95% CI 1.01, 4.10]), early involvement of parents in feeding support (1.94 [1.23, 3.04]), unit training in a neurodevelopmental care programme (2.57 [1.18, 5.60]), and in regions with a high level of BMF initiation in the general population (1.85 [1.05, 3.28]). Creating synergies by interventions at the unit and population level may reduce the variability in BMF rates at discharge for moderate preterm infants.

KEYWORDS

breastfeeding support, breast milk, cohort study, practice, preterm infant, policy

1 | INTRODUCTION

Breast milk feeding (BMF) is universally acknowledged as providing health benefits for infants born at term and even more so for preterm infants, in terms of protecting against gastrointestinal and respiratory illnesses and improving neurodevelopmental outcomes (Victora et al., 2016). Despite this evidence, preterm infants have lower rates of BMF at discharge and shorter duration as compared with term infants (Bonet et al., 2011; Bonnet et al., 2018; Rayfield, Oakley, & Quigley, 2015).

Promotion of BMF is now recognized as a collective responsibility (Rollins et al., 2016). In term infants, a multidimensional approach including a mixture of interventions involving the health system and the community environment seems a key strategy to protect, promote, and support optimal BMF practices (Rollins et al., 2016; Sinha et al., 2015). Preterm infants hospitalized in neonatal units, and interventions at this level potentially have high impact on BMF at discharge (Callen & Pinelli, 2005). Facilitating factors and barriers to BMF in preterm infants has been mainly studied in very preterm and late preterm infants (Bonet et al., 2015; Gianni et al., 2016; Kair, Flaherman, Newby, & Colaizy, 2015; Meier, Patel, Wright, & Engstrom, 2013; Mitha et al., 2019; Rayfield et al., 2015; Wilson et al., 2018). Recent cohort studies have emphasized the great variability among neonatal intensive care units (NICUs) in rates of BMF at discharge for very preterm infants (Lee & Gould, 2009; Mitha et al., 2019; Powers, Bloom, Peabody, & Clark, 2003; Wilson et al., 2018). However, data are lacking for moderate preterm infants, who account for a large proportion of preterm infants (Ananth, Friedman, & Gyamfi-Bannerman, 2013; Blencowe et al., 2012). In France, and in many other countries, preterm infants born at 32 to 34 weeks' gestation (WG) are hospitalized in neonatal units, unlike infants born at 35 to 36 WG, who may stay in level I units (well-newborn maternity wards) (Escobar, Clark, & Greene, 2006; Stark & American Academy of Pediatrics Committee on Fetus and Newborn, 2004). We previously explored factors available to change at the unit level and associated with BMF at discharge in very preterm infants (Mitha et al., 2019) and were interested to investigate whether such factors were similar for infants born at 32 to 34 WG.

The EIPAGE-2 cohort is a French national cohort of infants born before 35 WG that is designed to survey neonatal unit policies and explore variations in clinical practices (Ancel & Goffinet, 2014). Data collection at individual and unit levels provides the opportunity to explore associations between unit policies and BMF at discharge. The objectives of the current study were to describe BMF at discharge for infants born at 32 to 34 WG included in the EIPAGE-2 cohort and to analyse factors associated with BMF at discharge, with a special interest in unit factors aiming to facilitate BMF of preterm infants.

2 | METHODS

2.1 | Study cohort

The EIPAGE-2 cohort is a French national, prospective, population-based cohort of preterm infants born 22 to 34 WG in 2011.

Key messages

- Rate of breast milk feeding at discharge varies widely among units for infants born at 32–34 weeks' gestation.
- Variation is partly explained by unit policies and regional cultures of breast milk feeding, regardless of individual factors.
- Policies to be strengthened are very early kangaroo care and parents' involvement in feeding support.
- Creating synergies via interventions aiming to facilitate breast milk feeding in neonatal units and in the general population may offer an opportunity to improve breast milk feeding in preterm infants.
- Further research should explore what determines the quality of protocols to implement best practices and how to ensure adherence.

Recruitment took place at birth in all maternity units in 25 French regions (21/22 metropolitan regions and four overseas regions). The only region that did not participate accounted for 2% of births in France in 2011 (Ancel & Goffinet, 2014). Children born at 32 to 34 WG were recruited for 5 weeks from May 2 to June 5, 2011.

2.2 | Population

Children included in this study were part of the EIPAGE-2 cohort. Inclusion criteria were birth 32 to 34 WG, admission to the same level III or -IIb perinatal centre (Stark & American Academy of Pediatrics Committee on Fetus and Newborn, 2004) during the first week of life and survival to hospital discharge. Infants born from HIV-positive mothers were excluded.

2.3 | Outcome

The main outcome measure was BMF at discharge (yes/no), defined as an infant being fed, exclusively or partially, with breast milk at discharge (Johnston, Landers, Noble, Szucs, & Viehmann, 2012). Methods of breast milk administration (breast or bottle) were also reported.

2.4 | Data collection

We used structured questionnaires to collect information at the individual and unit level. The aim of unit questionnaires was to explore units' policies and their association with practices; they were based on self-reported declarations, under the responsibility of the team manager. At the unit level, information used to describe unit policies to facilitate BMF at discharge were BMF information systematically given to mothers hospitalized for threatened very preterm delivery; protocols for the use of human milk or BMF; a special room in the unit

for mothers to pump their milk; presence in the unit of a professional trained in human lactation (yes/no; training in human lactation defined as certification as an International Board Certified Lactation Consultant or having a French master's level diploma in Breast Feeding and Human Lactation [Pierrat et al., 2016]) and the dedicated time of this professional to support lactating mothers (no, part-time, full-time); availability of breast pumps in maternity wards or neonatal units (yes/no); use of donor milk for very preterm infants who did not receive BMF from their own mothers (yes/no); and implementation of a neurodevelopmental care training programme in the unit (absent, introductory course, sensory-motor programme, and Newborn Individualized Developmental Care and Assessment Program [NIDCAP; implemented or in progress]; Pierrat et al., 2016). To better describe the regional unit environment regarding BMF, we also extracted data from the 2010 French National Perinatal Survey to consider regional BMF initiation rates in the general population. Regional BMF initiation rates in the general population were estimated from a national sample of 14,761 live births representative of all births in 2010 (Blondel, Coulm, Bonnet, Goffinet, Le Ray, & National Coordination Group of the National Perinatal Surveys, 2017) and classified into terciles (low, intermediate, and high). Finally, general characteristics used to describe perinatal centres were level III or IIb unit (Stark & American Academy of Pediatrics Committee on Fetus and Newborn, 2004) and volume. Volume was defined as the total number of preterm infants born at 32 to 34 WG admitted during the first week of life in each perinatal centre in 2011. This number was obtained from the national hospital discharge database ("Programme de médicalisation du système d'information"—used to determine the activity-based funding of French hospitals) and classified into terciles (low, intermediate, and high).

At the individual level, maternal data used in this study were (a) sociodemographic characteristics: age, birthplace (France or other countries), parents' socio-economic status (highest occupational status for occupations of mother and father, or mother only if a single parent [Ancel & Goffinet, 2014]), parents cohabitating (yes/no); (b) obstetric characteristics: parity (primiparous and multiparous) and caesarean section (yes/no); and (c) factors already known to be associated with BMF at discharge (Rollins et al., 2016): smoking during pregnancy (yes/no), body mass index (underweight, normal range, overweight, and obese). Data at the infant level used were (a) main characteristics: gestational age (GA), small-for-GA (birth weight < 10th percentile for GA and sex based on French intrauterine growth "EPOPE" curves [Ego et al., 2016]), multiple birth (yes/no), number of units before discharge (1, ≥ 2), neonatal jaundice treated by phototherapy (yes/no), early onset sepsis within the first 72 hr of life (yes/no), late onset sepsis after 72 hr of life (yes/no), and severe neonatal morbidity (yes/no). Severe neonatal morbidity was defined as any of the following outcomes (Ancel & Goffinet, 2014): intraventricular haemorrhage grade III or IV (Papile, Burstein, Burstein, & Koffler, 1978), cystic periventricular leukomalacia (Volpe, 2009), necrotizing enterocolitis (Bell stages II and III; Bell et al., 1978), and/or severe bronchopulmonary dysplasia, defined as oxygen administration for at least 28 days plus the need for 30% or more oxygen and/or mechanical ventilatory support or continuous positive

airway pressure at 36 weeks' postmenstrual age (Jobe & Bancalari, 2001); (b) variables related to BMF: initiation of lactation during the first week (yes/no), BMF at discharge (yes/no), date and type of first enteral feed; and (c) practices aiming to facilitate BMF: provision of KC during the first week of life (yes, in the first 24 hr; yes, after the first 24 hr and before day 7; no) and early involvement of parents in feeding support (defined as swaddling and/or sucking and/or KC during a feed during the first week of life).

2.5 | Data analysis

We first described BMF at discharge, general characteristics of the units and practices and unit policies aiming to facilitate BMF. We then studied associations between individual and unit characteristics and BMF at discharge by bivariate analysis. Finally, we performed multilevel logistic regression analysis to investigate associations between BMF at discharge and individual and unit characteristics, with infants as level 1 and units where they spent their first week of life as level 2 to account for the hierarchical nature of data. Potential confounding factors were identified as characteristics associated with BMF in our sample or as relevant factors from the literature (Flacking, Nyqvist, & Ewald, 2007; Rollins et al., 2016). Independent variables of interest were those related to unit characteristics: volume of units, practices and policies aiming to facilitate BMF at discharge, and BMF initiation rates in the general population in the region. First, we estimated a random intercept model without any predictor variables (Model 1) to obtain the baseline unit-level variance ($\text{var}^{(1)}$). In Model 2, we included individual characteristics to investigate the association of individual-level variables with BMF at discharge and estimate the proportion of unit level variance that may be accounted for by differences in individual-level characteristics across units ($\text{var}^{(2)}$). We used the proportional change in variance by the new model compared with the empty model ($\text{PCV} = [\text{var}^{(1)} - \text{var}^{(2)}] / \text{var}^{(1)}$) to assess the extent to which unit differences in BMF rate at discharge may be explained by differences in the distribution of individual characteristics across units. In Model 3, we added unit characteristics to investigate the association of unit characteristics with BMF at discharge and calculated the PCV between Models 1 and 3 ($\text{PCV} = [\text{var}^{(1)} - \text{var}^{(3)}] / \text{var}^{(1)}$) to assess the extent to which unit differences in BMF rate at discharge may be explained by differences in the distribution of unit characteristics across units.

We compared infants without and with missing data on BMF at discharge. Cases with missing data represented 19% of the sample and were mainly due to KC during the first week of life (6.9%), parents' socio-economic status (4.8%), and BMF at discharge (6.3%). There were no missing data on unit characteristics. We performed multiple ($n = 19$) imputations of covariates and the outcome BMF at discharge by chained equations (White, Royston, & Wood, 2011) to limit bias due to missing data on the outcome and covariates. Estimates were combined across imputed data sets using Rubin rules (Rubin, 1987). Complete cases analysis is presented in a supplemental file.

As a sensitivity analyses, we examined the potential impact of multiple births with a model using mothers (as opposed to infants) as our level 1 of observation to take into account the non-independence of

multiple births. In this model, a mother of multiples was considered to breastfeed if she breastfed at least one of her infants at discharge. Variables describing infant characteristics (small-for-GA, KC during the first week of life, early involvement of parents in feeding support, and caesarean section) were considered present if at least one infant was affected.

All tests were two-sided and odds ratios (ORs), and 95% confidence intervals (CIs) were estimated. Stata v13 was used for analysis (StataCorp, College Station, TX).

3 | RESULTS

3.1 | Study population

Among the 1,206 infants born at 32 to 34 WG, 1,193 survived to discharge; 883 infants (717 mothers) were included in the study, and 828 had data for BMF at discharge (Figure 1). As compared with infants without missing data on BMF status at discharge ($N = 828$), those with missing data ($N = 55$) were born from parents with lower socioeconomic status and from mothers who smoked during pregnancy (Supplemental Table S1).

Infants were hospitalized in 131 different perinatal centres: 65 Level-III NICUs, 66 Level-IIb units, and 81% (660/813, missing data for 15 infants) were admitted in the same unit during the hospital stay and not transferred to a higher or lower level neonatal unit. The median number of infants born at 32 to 34 WG admitted per unit in 2011 was 78 (range 18–254).

3.2 | Initiation of BMF and BMF at discharge

Among the study population, initiation of BMF during the first week was 72% (567/791, missing data for 37 infants) and 59% (490/828) received BMF at discharge, ranging from 27% to 87% among units

with more than 10 infants born at 32 to 34 WG included in EPIPAGE-2 over the study period (19 Level-III and three Level-IIb units). Among infants fed with breast milk at discharge, 52% had exclusive BMF at discharge (255/490, 95% CI [48, 56]); modalities of feeding were breast (30%; 147/490), breast and bottle (57%; 277/490), and bottle (13%; 66/490).

3.3 | Unit policies and practices for BMF support

Breast pumps were available in maternity wards or neonatal units in 121/121 units (10 units with missing data). Overall, 87% (114/131) of units reported using donor milk for very preterm infants whose mothers did not express milk; 51% (67/131) reported that a professional trained in human lactation was available, and this professional was full-time dedicated for BMF support in 22% (15/67) of units, part-time dedicated for BMF support in 34% (23/67), and not at all dedicated for BMF support in 43% (29/67); 71% (93/131) reported that BMF information was systematically given to mothers hospitalized for threatened very preterm delivery; 87% (114/131) had protocols for the use of human milk or BMF; 68% (89/131) had a special room for mothers to pump their milk; and 50% (65/131) had no training in neurodevelopmental care (Table 2). KC in the first 24 hr involved 16% (122/777) of the infants, and parents of 77% (634/824) were involved in early feeding support. In addition, 92% of the infants (704/764, missing data for 64 infants) received enteral feed within 1 day, with human milk for 38%, from their own mother or a donor.

3.4 | Factors associated with BMF at discharge

Maternal and infant characteristics associated with BMF at discharge are reported in Table 1. BMF rates at discharge were significantly increased in units with BMF information systematically given to

FIGURE 1 Flow chart of the study population

*The design of the EPIPAGE-2 cohort study did not provide unit questionnaires for level-IIa units

mothers hospitalized for threatened preterm delivery and in units implementing a sensory motor programme (Table 2).

We explored the association between BMF at discharge and regional rates of BMF initiation in the general population (Table 3). In 2010, BMF initiation rates in French maternity wards were 69% (95% CI [68, 69]) and ranged from 59% to 84% among regions. BMF rates at initiation and discharge for infants at 32 to 34 WG were significantly associated with regional BMF initiation rates in the general population.

BMF at discharge rates varied across units (Table 4). The inclusion of individual variables (Model 2) slightly reduced the variance and explained 7.6% of the variation across units. The probability of BMF at discharge increased with KC during the first 24 hr of life and with early involvement of parents in feeding support. The inclusion of unit variables (Model 3) reduced the variance and explained 39.2% of the variation across units. After adjustment for individual-level variables, BMF at discharge was higher in units implementing a sensory motor programme and with a high regional BMF initiation rate in the general population. Detailed results for each individual variable included in the model are available in Supplemental Table S2. The multilevel logistic regression analysis for the 716 complete cases (81% of the population) is available in Supplemental Table S3. When models were run with mothers used as the unit of observation instead of infants, results were in the same direction, consistent with our main analyses (Supplemental Table S4).

4 | DISCUSSION

This population-based study highlighted the great variability among units in BMF at discharge for infants born at 32 to 34 WG, with a mean rate of 59%, ranging from 27% to 87%. This variation was poorly explained by maternal and neonatal characteristics and mainly by unit practices or policies. Infants with BMF at discharge had KC during the first 24 hr of life and involvement of parents in early feeding support and were in units featuring neurodevelopmental care training with a sensorimotor programme. In addition, BMF at discharge in this population was associated with regional BMF initiation rates in the general population.

4.1 | Strengths and limitations

Most studies investigating factors associated with BMF in preterm infants focused on very preterm infants (Blencowe et al., 2012). The EPIPAGE-2 cohort provided the opportunity to study at a national level infants born at 32 to 34 WG, for whom the neonatal course and parental experiences during hospitalization differ from those of very preterm infants, with potentially different factors influencing BMF at discharge (Blencowe et al., 2012; Natarajan & Shankaran, 2016). A second strength of the study is the simultaneous recording of maternal, infant, and unit characteristics that allowed for investigating factors at different care levels potentially associated with BMF at discharge. In addition, the cohort study design, reflecting the diversity

of everyday clinical practice, may help define strategies to improve BMF at discharge for preterm infants born at 32 to 34 WG.

One limitation is the missing data. Infants with missing data on BMF status at discharge had individual characteristics associated with lower BMF rate at discharge, and this rate may have been overestimated, but the observed associations were similar with multiple imputation and complete cases. We focused on unit policies, but some of the data, such as KC and involvement of parents in feeding support, were available at the individual level and others, like BMF information systematically given to mothers hospitalized for threatened very preterm delivery, were based on unit declarations. Consequently, adherence to declared unit policies supporting BMF was not always measured. However, we have already shown that self-reported unit policies were associated with practices (Pierrat et al., 2016), and our results, showing an association between declared policies and BMF at discharge, suggest at least partial adherence. Another limitation is that factors already known to influence BMF and modalities of BMF (Meier, Johnson, Patel, & Rossman, 2017), such as maternal motivations to breastfeed or not, previous experience with BMF, maternal stress and fatigue, and insufficient social support, were not available in the EPIPAGE-2 data collection. More importantly, the design of this national study did not allow for recording modalities of information of parents and education of health care professionals, which may lead to inconsistent advice for parents, negatively associated with BMF (Alves, Rodrigues, Fraga, Barros, & Silva, 2013).

4.2 | Comparisons with other findings and interpretation

As compared with the BMF rate at discharge for infants born at 32 to 34 WG from the first EPIPAGE study of infants born in 1997 (Ancel & Goffinet, 2014; 30.3%, personal data), the rate has increased substantially in France (59%) but is still far from the World Health Organization nutrition targets for 2025: increase the exclusive BMF in the first 6 months up to at least 50% (WHO, 2014). Data from other countries have highlighted the lower improvement in BMF rate at discharge for moderate preterm infants compared with very preterm infants (Campbell & Miranda, 2018; Charkaluk et al., 2018; Colaizy, Saftlas, & Morriss, 2012), which suggests the need for neonatal units to encourage BMF not only for very preterm infants but also for moderate infants. Despite the progress observed in French neonatal units, we report a large variability in BMF rate at discharge. This variability was also described in U.S. NICUs for very preterm infants and in European regions, with individual determinants explaining only part of the variability among sites (Powers et al., 2003; Wilson et al., 2018). In our study, variability among units was also marginally explained by individual determinants. These determinants were social determinants of mothers, already well described in the literature (Rollins et al., 2016), and smoking during pregnancy. These mothers could benefit of targeted information and support to help them BMF their preterm baby. Unlike very preterm infants included in EPIPAGE-2 (Mitha et al., 2019), infant characteristics were not associated with BMF at

TABLE 1 Breast milk feeding at discharge for preterm infants born at 32 to 34 weeks' gestation and included in the EPIPAGE-2 cohort study by maternal and infant characteristics

	Breast milk feeding at discharge N = 828		
	Total	n (%)	Unadjusted OR (95% CI)
Maternal characteristics			
Maternal age, years			
<25	123	66 (53.7)	0.76 [0.51, 1.13]
25–34	517	312 (60.3)	1.00 [Reference]
>34	188	112 (59.6)	0.97 [0.69, 1.36]
Parents cohabitating (n = 817)			
Yes	741	449 (60.6)	1.00 [Reference]
No	76	37 (48.7)	0.62 [0.38, 0.99]
Parents' socio-economic status ^a (n = 789)			
Professional	193	145 (73.7)	1.00 [Reference]
Intermediate	187	107 (56.0)	0.44 [0.29, 0.68]
Administration, public service, self-employed, students	213	126 (60.8)	0.48 [0.31, 0.73]
Shop assistants, service workers	100	51 (51.6)	0.34 [0.21, 0.57]
Manual	75	38 (51.2)	0.34 [0.19, 0.59]
Unemployed	21	9 (40.7)	0.25 [0.10, 0.62]
Birthplace (n = 820)			
France	657	378 (57.5)	1.00 [Reference]
Other	163	108 (66.3)	1.45 [1.01, 2.08]
Smoking during pregnancy (n = 819)			
No	674	431 (63.9)	1.00 [Reference]
Yes	145	55 (37.9)	0.34 [0.24, 0.50]
Parity (n = 819)			
Primiparous	456	219 (63.8)	1.00 [Reference]
Multiparous	363	191 (52.6)	0.63 [0.47, 0.83]
Body mass index, kg/m ² (n = 809)			
18.5–24.9 (normal)	487	296 (60.8)	1.00 [Reference]
<18.5 (underweight)	72	30 (41.7)	0.46 [0.28, 0.76]
25.0–29.9 (overweight)	151	98 (64.9)	1.19 [0.81, 1.74]
≥ 30 (obese)	99	57 (57.6)	0.88 [0.56, 1.36]
Caesarean section (n = 826)			
No	361	232 (64.3)	1.00 [Reference]
Yes	465	257 (55.3)	0.70 [0.51, 0.91]
Infant characteristics			
-At birth			
Gestational age, weeks			
32	212	118 (55.6)	1.00 [Reference]
33	255	167 (65.5)	1.51 [1.04, 2.20]
34	361	205 (56.8)	1.05 [0.74, 1.47]
Small-for-gestational age ^b (827)			
No	529	337 (63.7)	1.00 [Reference]
Yes	298	153 (51.3)	0.60 [0.45, 0.80]

(Continues)

TABLE 1 (Continued)

	Breast milk feeding at discharge N = 828		
	Total	n (%)	Unadjusted OR (95% CI)
Multiple birth			
No	513	306 (59.7)	1.00 [Reference]
Yes	315	184 (58.4)	0.95 [0.71, 1.26]
-Postnatal			
KC during the first week of life (n = 777)			
No	102	46 (45.1)	1.00 [Reference]
Yes, in the first 24 hr	122	80 (65.6)	2.32 [1.35, 3.98]
Yes, after the first 24 hr and before day 7	553	341 (61.7)	1.96 [1.28, 3.00]
Early involvement of parents in feeding support for the infant ^c (n = 824)			
No	190	93 (48.9)	1.00 [Reference]
Yes	634	396 (62.5)	1.73 [1.25, 2.41]
Neonatal jaundice treated by phototherapy (n = 807)			
No	265	155 (58.5)	1.00 [Reference]
Yes	542	321 (59.2)	1.03 [0.76, 1.39]
Early onset sepsis ^d (n = 828)			
No	767	459 (59.8)	1.00 [Reference]
Yes	61	31 (50.8)	0.69 [0.41, 1.17]
Late onset sepsis ^e (n = 825)			
No	804	475 (59.1)	1.00 [Reference]
Yes	21	13 (61.9)	1.13 [0.46, 2.75]
Severe neonatal morbidity ^f			
No	812	482 (59.4)	1.00 [Reference]
Yes	16	8 (50.0)	0.68 [0.25, 1.84]
Number of units before discharge (n = 803)			
1	660	388 (58.8)	1.00 [Reference]
≥2	153	90 (58.8)	1.00 [0.70, 1.43]

Abbreviations: KC, Kangaroo care; OR, odds ratio; 95% CI, 95% confidence interval.

^aDefined as the highest occupational status between occupations of the mother and the father, or mother only if living alone (Ancel et al., 2015).

^bDefined as birth weight < 10th percentile for gestational age and sex based on French EPOpé intrauterine growth curves (Ego et al., 2016).

^cDefined as swaddling and/or sucking and/or KC during a feed.

^dEarly onset sepsis occurs within the first 72 hr of life.

^eLate onset sepsis occurs after 72 hr of life.

^fDefined as severe intraventricular haemorrhage or cystic periventricular leukomalacia; and/or necrotizing enterocolitis stages (Bell stages II to III); and/or severe bronchopulmonary dysplasia (Ancel et al., 2015).

discharge in this population of moderate preterm infants. Most of these infants stayed in the same unit until discharge, which strengthens the role of unit policies to support BMF (Campbell & Miranda, 2018; Colaizy et al., 2012; Herich et al., 2017; Mitha et al., 2019; Rayfield et al., 2015; Rodrigues, Severo, Zeitlin, & Barros, 2018; Wilson et al., 2018).

4.3 | Implication for practice

This current study covers a large spectrum of neonatal units in France and describes a widespread environment facilitating BMF as described

by Wilson et al. (2018), with breast pumps in all units, wide use of protocols for BMF, and donor milk for very preterm infants whose mothers did not provide breast milk, but with only 5 units labelled "baby-friendly" in 2011. Our results suggest that even if facilities and equipment are provided, an in-depth approach, as proposed by the Baby Friendly Hospital Initiative (WHO & UNICEF, 2018), is needed to better understand the complexity of BMF for preterm infants born at 32 to 34 WG. Breast milk banks, known to positively affect BMF (Parker, Burnham, Mao, Philipp, & Merewood, 2016; Wilson et al., 2018), are also well distributed in France and contribute to the diffusion of facilities (Human milk bank French association, 2016).

TABLE 2 Breast milk feeding at discharge for preterm infants born at 32 to 34 weeks' gestation and included in the EPIPAGE-2 cohort study by unit characteristics

	Breast milk feeding at discharge N = 828		
	Total	n (%)	Unadjusted OR ^a (95% CI)
Level of the units			
Level III (65/131 units)	560	332 (59.3)	1.00 [Reference]
Level IIb (66/131 units)	268	158 (59.0)	0.99 [0.97, 1.02]
Volume of the units ^b			
Low (first tercile; 44/131 units)	143	74 (51.8)	1.00 [Reference]
Intermediate (second tercile; 44/131 units)	238	138 (58.0)	1.28 [0.68, 2.41]
High (third tercile; 43/131 units)	447	278 (62.2)	1.74 [0.95, 3.16]
Breast milk feeding information systematically given to mothers hospitalized for threatened very preterm delivery			
No (38/131 units)	213	109 (51.2)	1.00 [Reference]
Yes (93/131 units)	615	381 (62.0)	1.72 [1.01, 2.92]
Protocols for human milk or breast milk feeding			
No (17/131 units)	81	38 (46.9)	1.00 [Reference]
Yes (114/131 units)	747	452 (60.5)	2.00 [0.92, 4.34]
A special room in the unit for mothers to pump their milk			
No (42/131 units)	220	127 (57.7)	1.00 [Reference]
Yes (89/131 units)	608	363 (59.7)	1.07 [0.63, 1.81]
Professional trained in human lactation ^c			
No (64/131 units)	304	185 (60.9)	1.00 [Reference]
Yes (67/131 units)	524	305 (58.2)	0.89 [0.55, 1.45]
Neurodevelopmental care training			
No training (65/131 units)	367	211 (57.5)	1.00 [Reference]
Introductory course (37/131 units)	233	129 (55.4)	0.83 [0.48, 1.83]
Sensory motor programme (17/131 units)	88	68 (77.3)	2.71 [1.23, 5.96]
NIDCAP (12/131 units)	140	82 (58.6)	1.17 [0.56, 2.42]

Abbreviations: NIDCAP, Newborn Individualized Developmental Care and Assessment Program; OR, odds ratio; 95% CI, 95% confidence interval.

^aORs values were obtained by multilevel analysis.

^bVolume was defined as the total number of preterm infants born at 32 to 34-week gestation admitted in the first week of life in each perinatal centre during 2011. This number was obtained from the national hospital discharge database and classified into terciles: median number of infants in low tercile, 42 (range 18 to 59); intermediate tercile, 78 (60 to 100); and high tercile, 127 (101 to 254).

^cTraining in human lactation included certification as an International Board Certified Lactation Consultant or the French master training in human lactation (Pierrat et al., 2016).

Nevertheless, the rate of first enteral feeding with human milk was lower in these moderately preterm infants compared with very preterm infants (38% vs. 80%; Mitha et al., 2019). Using donor milk for infants born after 32 WG when the mother's milk is not available was not recommended in France in 2011 because of insufficient reserves. A more active policy to encourage milk donation to have enough human milk for all preterm infants may be another target of action to increase BMF at discharge.

Although we considered early involvement of parents in feeding support for the infant and KC at the individual level, these practices depend on both parent-infant characteristics and unit policies (Palás-Alonso et al., 2012; Pierrat et al., 2016). Early involvement of

parents in feeding support depends on both the will of parents and also the incentive of units, within a family-centred care context (Cooper et al., 2007; Gianni et al., 2018). Our definition of parents' feeding support was general but depended on team support to encourage parents to be involved in the care of their infants (Skene, Franck, Curtis, & Gerrish, 2012). Even if we were not able to describe the "dose" of KC in detail, our finding that unlike KC after 24 hr of life, early KC in the first 24 hr after birth associated with BMF at discharge is consistent with the recommendation of KC after preterm birth to support bonding and attachment as well as BMF (Casper, Sarapuk, & Pavlyshyn, 2018; Conde-Agudelo & Díaz-Rossello, 2016; McInnes & Chambers, 2008). Early KC after delivery is a feasible practice, not expensive to

TABLE 3 Breast milk feeding initiation and at discharge for preterm infants born at 32 to 34 weeks' gestation and included in the EPIPAGE-2 cohort by regional rates of breast milk feeding initiation in the general population

Regional breast milk feeding initiation rates in the French population ^a	EPIPAGE-2 cohort study							
	Breast milk feeding initiation ^b (N = 791)				Breast milk feeding at discharge ^c (N = 828)			
	Total infants	n	% (95% CI)	Overall p value	Total infants	n	% (95% CI)	Overall p value
Low (first tercile)	260	179	68.8 [63.2, 74.4]	.03	269	143	53.2 [47.3, 59.2]	<.01
Intermediate (second tercile)	237	161	67.9 [61.9, 73.8]		256	138	53.9 [47.8, 60.0]	
High (third tercile)	294	227	77.2 [72.4, 82.0]		303	209	69.0 [63.8, 74.2]	

Abbreviation: 95% CI, 95% confidence interval.

^aRegional breast milk feeding initiation rates in the French population were extracted from the French National Perinatal Survey (Blondel et al., 2017) and classified into terciles (n/N, % [95% CI]): low, 3043/5089, 59.8% (58.4, 61.1); intermediate, 2770/3995, 69.3% (67.7, 70.9); and high 4324/5573, 77.6% (76.5, 78.7). Breast milk feeding was recorded on Days 2 to 3 after birth.

^bBreast milk feeding initiation (n/N, % [95% CI]): 567/791, 72% (69–75) was defined as initiation of lactation (yes/no) during the first week of life.

^cBreast milk feeding at discharge (n/N, % [95% CI]): 490/828, 59% (range 56–62%) was defined as an infant fed breast milk at discharge (yes/no), exclusively or partially.

implement, and a high KC “dose” is associated with earlier attainment of exclusive BMF at discharge (Oras et al., 2016). These two practices are however linked to unit's policies promoting parental presence with the possibility for parents to stay overnight that has been shown to play a major role in establishing parent–infant closeness (Cuttini et al., 2019; Raikila et al., 2017).

Among all best practices in the complex process of promoting and protecting BMF (Meier et al., 2017; Spatz, 2004), the initiation of lactation is crucial, highly depends on information on milk expression, and allows for sufficient human milk volume to achieve the mother's BMF goal (Hoban et al., 2015; Meier et al., 2017). Even if a small group of infants was hospitalized in two or more units and we thus cannot assign BMF at discharge to policies of the first unit only, we hypothesize that a successful initiation of lactation is determinant for BMF at discharge, even in case of transfer. In our study, most of the units delivered antenatal information on BMF, which is considered the first step of lactation initiation allowing for an informed decision about the benefits and management of BMF (Spatz, 2004; WHO, & UNICEF, 2018). After this initiation period, the maintenance of lactation through to discharge remains challenging (Meier et al., 2017). Protocols for the use of human milk may reflect an interest of the unit in BMF (Meier et al., 2017; Wilson et al., 2018) even if we do not have data on the quality of protocols used. BMF support also implies a family-centred care context, with mothers receiving information on how to identify their infants' hunger cues (Cooper et al., 2007; Gianni et al., 2018; Whetten, 2016). Relationships between parents and health care professionals, in terms of consistent BMF education and support, are among the main facilitators in BMF a preterm infant according to parents' views (Alves et al., 2013; Gianni et al., 2018). In our study, half of the breastfed infants had exclusive BMF at discharge, which suggests the need for further improvement, especially because continuation is more likely with exclusive BMF at discharge

as opposed to mixed BMF (Bonnet et al., 2018). Unfortunately, we did not have enough data to explore enteral tube feeding and the transition from tube to oral BMF in our population (Browne & Ross, 2011). Managing this transition remains a challenge and affects BMF continuation to 6 months (Bonnet et al., 2018; Briere, McGrath, Cong, Brownell, & Cusson, 2015; McInnes, Shepherd, Cheyne, & Niven, 2010; Pineda, 2011). Neurodevelopmental care training programmes may have an impact on this transition (Browne & Ross, 2011), and we assume that the sensorimotor programme (Martinet et al., 2013), encouraging oral stimulation, has an impact through this pathway.

Professional support can increase successful BMF, with clinically trained, experienced professionals influencing both the initiation and maintenance of lactation (Kramer et al., 2001). Our group previously reported an association of the presence in units of professionals trained in human lactation with an increase in breast milk expression during the first week of life (Pierrat et al., 2016). However, in this study, as in our study on very preterm infants (Mitha et al., 2019), the presence in units of professionals trained in human lactation was not associated with BMF at discharge. We have considered several hypotheses to understand this surprising result in line with the heterogeneous presence of these professionals among units and the absence of available information on strategies used for BMF support. The presence of trained professionals per se may not be a determinant but should be analyzed in light of changes in organizational processes associated with this presence.

Supporting BMF is a complex process, which is intricate to split into several policies, but has to be analysed as a whole (Meier et al., 2017; Rollins et al., 2016; Spatz, 2004). Multifactorial determinants are involved in BMF rate, particularly societal attitudes (Rollins et al., 2016). In this population of moderate preterm infants, unlike very preterm infants (Mitha et al., 2019), BMF rates at initiation and discharge

TABLE 4 Individual and unit characteristics associated with breast milk feeding at discharge among preterm infants born at 32 to 34 weeks' gestation and included in the EIPAGE-2 study: multiple imputation

Fixed effects N = 883	Model 1 Empty model	Model 2 Individual characteristics Adjusted OR ^a (95% CI)	Model 3 Individual and unit characteristics Adjusted OR ^a (95% CI)
KC during the first week of life			
No		1.00 [Reference]	1.00 [Reference]
Yes, in the first 24 hr		2.15 [1.07, 4.31]	2.03 [1.01, 4.10]
Yes, after the first 24 hr and before Day 7		1.71 [1.01, 2.91]	1.53 [0.89, 2.62]
Early involvement of parents in feeding support for the infant ^b			
No		1.00 [Reference]	1.00 [Reference]
Yes		1.71 [1.09, 2.68]	1.94 [1.23, 3.04]
Volume of the units ^c			
Low (first tercile)			1.00 [Reference]
Intermediate (second tercile)			1.21 [0.63, 2.31]
High (third tercile)			1.35 [0.69, 2.55]
Breast milk feeding information systematically given to mothers hospitalized for threatened very preterm delivery			
No			1.00 [Reference]
Yes			1.25 [0.75, 2.09]
Protocols for human milk or breast milk feeding			
No			1.00 [Reference]
Yes			1.91 [0.89, 4.11]
A special room in the unit for mothers to pump their milk			
No			1.00 [Reference]
Yes			0.80 [0.47, 1.34]
Professional trained in human lactation ^d			
No			1.00 [Reference]
Yes			0.77 [0.47, 1.24]
Neurodevelopmental care training			
No training			1.00 [Reference]
Introductory course			0.74 [0.44, 1.27]
Sensory motor programme			2.57 [1.18, 5.60]
NIDCAP			1.18 [0.56, 2.49]
Regional breast milk feeding rate ^e			
Low			1.00 [Reference]
Intermediate			0.98 [0.55, 1.74]
High			1.85 [1.05, 3.28]
Random effects			
Variance for neonatal units	0.823	0.760	0.500
PCV ^f	Reference	7.6%	39.2%

Abbreviations: KC, Kangaroo care; NIDCAP, Newborn Individualized Developmental Care and Assessment Program; OR, odds ratio; 95% CI, 95% confidence interval.

^aAdjusted for maternal age, parents cohabitating, parents' socio-economic status, maternal birth place, smoking during pregnancy, parity, body mass index, caesarean section, gestational age, small-for-gestational age, multiple birth (data available in supplemental file, Table S2).

^bDefined as swaddling and/or sucking and/or KC during a feed.

^cVolume was defined as the total number of preterm infants born at 32 to 34-week gestation admitted in the first week of life in each perinatal centre during 2011. This number was obtained from the national hospital discharge database and classified into terciles: median number of infants in low tercile, 42 (range 18 to 59); intermediate tercile, 78 (60 to 100); and high tercile, 127 (101 to 254).

^dTraining in human lactation included certification as an International Board Certified Lactation Consultant or the French master training in human lactation (Pierrat et al., 2016).

^eThe rate of breast milk feeding in the general population, extracted from the French National Perinatal Survey (Blondel et al., 2017), was classified into terciles (n/N, % [95% CI]): low, 3,043/5,089, 59.8% [58.4, 61.1]; intermediate, 2,770/3,995, 69.3% [67.7, 70.9]; and high 4,324/5,573, 77.6% [76.5, 78.7]. Breast milk feeding was recorded on Days 2 and 3 after birth.

^fPCV = proportional change in variance by the new model compared to the empty model.

were associated with BMF rates in the general population. Even if most variables associated with BMF at discharge were common for very and moderate preterm infants, the fact that the regional BMF initiation rates in the general population may have different effects deserves attention. We believe that this finding emphasizes the collective societal responsibility (Rollins et al., 2016) to support BMF for all neonates, even if neonatal team attitudes play a role in encouraging BMF at discharge for preterm neonates (Charkaluk et al., 2018).

5 | CONCLUSION

In this national population-based cohort of preterm infants born at 32 to 34 WG, unit policies were associated with BMF at discharge. Variability between units was potentially explained by unit policies and the BMF culture in the general population. Adopting policies of higher performing units offers an effective strategy and realistic potential for neonatal units to increase BMF rates at discharge in this population of preterm infants. Further research should explore the modalities of implementation of best practices.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

AM had full access to all the data in the study, conceptualized the study, performed the statistical analysis, drafted the initial manuscript, and takes responsibility for the integrity of the data and the accuracy of the data analysis. AP had full access to all the data in the study, advised on the statistical analysis, and takes responsibility

for the accuracy of the data analysis. PYA designed the EPIPAGE-2 study, obtained funding, supervised data collection, supervised the analyses, and reviewed and revised the manuscript, and takes responsibility for the integrity of the data and accuracy of the data analysis. VP had full access to all the data in the study, conceptualized the study, contributed to the analysis plan and interpretation of the results, revised the manuscript, and takes responsibility for the integrity of the data and accuracy of the data analysis. MK conceptualized the study and critically reviewed the manuscript for important intellectual content. MD coordinated data collection and had responsibility for technical support. BK, IG, JMR, BB, and AB contributed to data collection, the analysis plan and interpretation of the results, and reviewed the manuscript. All authors have seen this version and approved the final content.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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APPENDIX A

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