

Exclusive breastfeeding and the impact of the NICU stay - a pilot prospective study

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Abstract

Introduction and Objectives: The World Health Organization aims for a prevalence of exclusive breastfeeding (EBF) at six months of $\geq 50\%$. Difficulties in EBF associated with Neonatal Intensive Care Unit (NICU) admission are documented, although with limited data in Portugal. The objective is to estimate the prevalence of EBF up to six months of age following NICU admission in the neonatal period and to evaluate factors related to EBF success. **Methods:** A prospective study was conducted on newborns admitted to a level III hospital NICU within the first 24 hours of life between October 2022 and January 2023. Data was collected by reviewing clinical records and interviews with caregivers during hospitalization and by telephone up to six months of age. **Results:** A total of 65 newborns were included with a mean gestational age of 35 weeks ($SD \pm 4$) and a mean birth weight of 2411 g ($SD \pm 836$). The primary reasons for hospitalization were prematurity (46%) and congenital anomalies (25%). At NICU discharge, 39% were under EBF. The prevalence of EBF was higher in newborns with a birth weight of < 1500 g ($p = 0.025$) and younger mothers ($p = 0.020$), but lower in cases of multiple pregnancies ($p = 0.047$). At two months of age, 29% maintained EBF, of which 53% were already on EBF at discharge. Up until six months of age, the prevalence of EBF was 14% while 29% continued with breastfeeding. **Discussion:** The prevalence of EBF at discharge was much lower than national data published regarding maternity unit discharge figures for healthy newborns. Determinants of EBF success were not identified and future studies with larger sample sizes are needed.

Keywords: Exclusive breastfeeding. Breastfeeding. Neonatal intensive care. Newborn. Prematurity.

Aleitamento materno exclusivo e o impacto do internamento na UCIN - um estudo piloto prospetivo

Resumo

Introdução e Objetivos: A Organização Mundial da Saúde tem como objetivo a prevalência do aleitamento materno exclusivo (AME) aos seis meses $\geq 50\%$. Estão descritas dificuldades no AME associadas ao internamento em Unidade de Cuidados Intensivos Neonatais (UCIN), embora existam dados limitados em Portugal. O objetivo é estimar a prevalência de AME até aos 6 meses de vida após internamento em UCIN no período neonatal e avaliar fatores relacionados com o sucesso de AME. **Métodos:** Estudo prospetivo, incluindo RN admitidos na UCIN de um hospital nível III nas primeiras 24 horas de vida, de Outubro 2022 a Janeiro 2023. Dados obtidos por consulta dos processos clínicos e entrevista aos cuidadores durante o internamento e por via telefónica até aos 6 meses. **Resultados:** Foram incluídos 65 RN com idade gestacional média 35 semanas ($DP \pm 4$) e peso médio 2411g

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(DP $\pm$ 836). Os principais motivos de internamento foram prematuridade (46%) e anomalias congénitas (25%). À alta da UCIN, 39% encontravam-se sob AME. A prevalência de AME foi superior nos RN com peso ao nascimento < 1500g ($p = 0,025$) e mães mais jovens ($p = 0,020$) e inferior nos casos de gravidez múltipla ($p = 0,047$). Aos dois meses de idade, 29% mantinham o AME, dos quais 53% já estavam em AME à alta. Até aos seis meses, 14% mantinham o AME e 29% mantinham leite materno. **Discussão:** A prevalência de AME à data de alta foi inferior aos dados nacionais publicados à alta da maternidade de RN saudáveis. Não foi possível encontrar determinantes do sucesso do AME, sendo necessários estudos futuros com maior poder amostral.

Palavras-chave: Amamentação materna exclusiva. Amamentação. Cuidados intensivos neonatais. Recém-nascidon. Prematuridade.

Keypoints

What is known

- Exclusive breastfeeding continues to be the optimal method for nourishing newborns.
- Difficulties in exclusive breastfeeding associated with Neonatal Intensive Care Unit admission are recognized.

What is added

- The exclusive breastfeeding rates after NICU stays were much lower than national data published regarding maternity unit discharge figures for healthy newborns.
- The prevalence of exclusive breastfeeding at discharge was higher in newborns with a birth weight of < 1500 g.
- NICU practices must be improved, extending beyond premature newborns, where there have been more efforts to reinforce breastfeeding.

Introduction and objectives

Human milk has a unique composition, with antimicrobial, anti-inflammatory, and immuno-regulatory functions, relevant to a child's developing immune system¹.

Exclusive breastfeeding continues to be the optimal method for nourishing newborns, serving as the cornerstone for infant health by supplying essential and irreplaceable nutrients that are vital to a child's growth and development¹⁻⁵. The World Health Organization (WHO) advocates for exclusive breastfeeding up to six months of age^{4,5}, with a WHO target of increasing the rate of exclusive breastfeeding in the first six months up to at least 50% by 2025⁶.

Breastfeeding, even if partial or for a shorter period than desirable, has a beneficial effect when compared to exclusive feeding with infant formula⁷.

According to the National Health Survey, the prevalence of exclusive breastfeeding in Portugal has shown an upward trend, yet it consistently falls below the recommended levels⁸.

National data reveals exclusive breastfeeding rates ranging from 76.7% to 78.8% at the time of maternity unit discharge, followed by a subsequent decline to 51.6% and 22.1% at two and five months of age, respectively⁹. Literature describes similar trends, with various factors identified as contributors to the early cessation of exclusive breastfeeding¹⁰⁻¹². There is also a link between neonatal intensive care unit (NICU) admission and heightened challenges in exclusive breastfeeding¹³⁻¹⁶, although available data for Portugal is limited.

The objectives of this pilot study were to estimate the prevalence of exclusive breastfeeding up to six months of age following NICU admission in the neonatal period at the time that the Human Milk Bank was implemented and to assess clinical factors (pertaining to pregnancy, delivery, and NICU admission) and/or sociodemographic variables linked to exclusive breastfeeding success.

Methods

A prospective longitudinal observational study was conducted, with the study population consisting of newborns admitted to the NICU of a level III hospital within the first 24 hours of life. Systematic random sampling was used, based on the list of NICU admissions and in line with the inclusion criteria. These included all newborns admitted to the NICU (both inborn and outborn infants) between October 2022 and January 2023, with hospitalization within the first 24 hours of life. Exclusions comprised newborns contraindicated for breastfeeding, those who died during hospitalization or the follow-up period, caregiver refusal to participate in the study, loss of follow-up, and newborns with brief hospital stays for elective procedures. Five losses of follow-up were recorded due to failure to respond to telephone calls.

Written information was given to caregivers and after informed consent was obtained, clinical records were reviewed and caregivers were interviewed during hospitalization and by telephone up to six months of age, using a structured questionnaire. Variables included data

pertaining to pregnancy, family context, delivery, NICU admission, and associated problems.

Statistical analysis was performed using the SPSS® program (IBM, USA) v.28. In the descriptive analysis, normally distributed continuous variables were characterized by the mean ($\pm$ standard deviation), while non-normally distributed variables were characterized by the median and interquartile range. Categorical variables were described by absolute and relative frequencies. The comparison between a continuous and a categorical variable was conducted through an independent t-test and Mann-Whitney U test for paired and independent samples, respectively. The comparison of two categorical variables was carried out using a chi-squared test and Fisher's exact test. Imputation was used to substitute reasonable guesses for missing data.

A p value of less than 0.05 was considered statistically significant.

Authorization was obtained from the hospital's Ethics Committee.

Results

A total of 70 newborns were recruited, with five lost at follow-up, resulting in a total sample of 65 participants. A descriptive analysis of the sample is summarized in [table 1](#).

The mean birth weight was 2411 grams ($\pm$ 836 grams), with a minimum of 940 grams and a maximum of 4065 grams. The mean gestational age was 35 ($\pm$ 4) weeks, ranging from a minimum of 26 weeks and two days to a maximum of 40 weeks and five days.

The primary reasons for hospitalization were prematurity (46%), followed by congenital anomalies (25%), predominantly cardiac and digestive ([Table 2](#)).

During hospitalization in the NICU, 62 newborns received their mother's milk, 16 met the criteria for donor human milk (DHM) of which 11 (69%) were fed with DHM, and 45 received formula milk at some point during their hospital stay.

At NICU discharge, 62 newborns (95%) were being breastfed and 25 (39%) were being exclusively breastfed. At two months of age, 19 (29%) were exclusively breastfed, of which 10 (53%) were already on exclusive breastfeeding at discharge. Nine (14%) continued with exclusive breastfeeding until six months and 19 (29%) maintained breastfeeding (not exclusive). At four months of age, nearly 23% had initiated complementary feeding and by six months of age, all newborns had started it. [Figure 1](#) illustrates the evolution of exclusive breastfeeding and any breastfeeding rates up to six months, compared to the WHO target for 2025 (above the red line).

Table 1. Sample descriptive analysis (n = 65)

	n (%)	Mean ($\pm$ SD) or median (IQR)
Maternal age years		31 ($\pm$ 5)
Multiparous mother	20 (31)	
Mother with higher education	27 (42)	
Employed mother	54 (83)	
Previous breastfeeding experience	22 (34)	
Multiple pregnancy	8 (12)	
Caesarean delivery	39 (60)	
Skin-to-skin contact in the first hour	26 (40)	
First contact with mother hours		1 (1-10)
Female newborn	35 (54)	
Newborn birth weight g		2411 ($\pm$ 836)
Gestational age weeks		35 ($\pm$ 4)
Length of stay days		12 (5-23)
Donor human milk use	11 (18)	
Need for surgery	6 (9)	

SD: standard deviation; IQR: interquartile range.

Table 2. Summary of reasons for NICU admission

Reasons for NICU admission	n (%)
Prematurity	30 (46)
Congenital anomalies	
Cardiac	6 (10)
Digestive	4 (6)
Polimalformative	3 (5)
Central nervous system	1 (1)
Other	2 (3)
Non-malformative cardiac pathology	1 (1)
Non-malformative neurologic pathology	3 (5)
Infectious risk/sepsis	7 (11)
Other	8 (12)

NICU: Neonatal Intensive Care Unit.

[Table 3](#) presents a comparative analysis of exclusive breastfeeding at NICU discharge concerning factors related to the mother and pregnancy. At NICU discharge, exclusive breastfeeding was more common in younger mothers ($p = 0.020$) and less common in cases

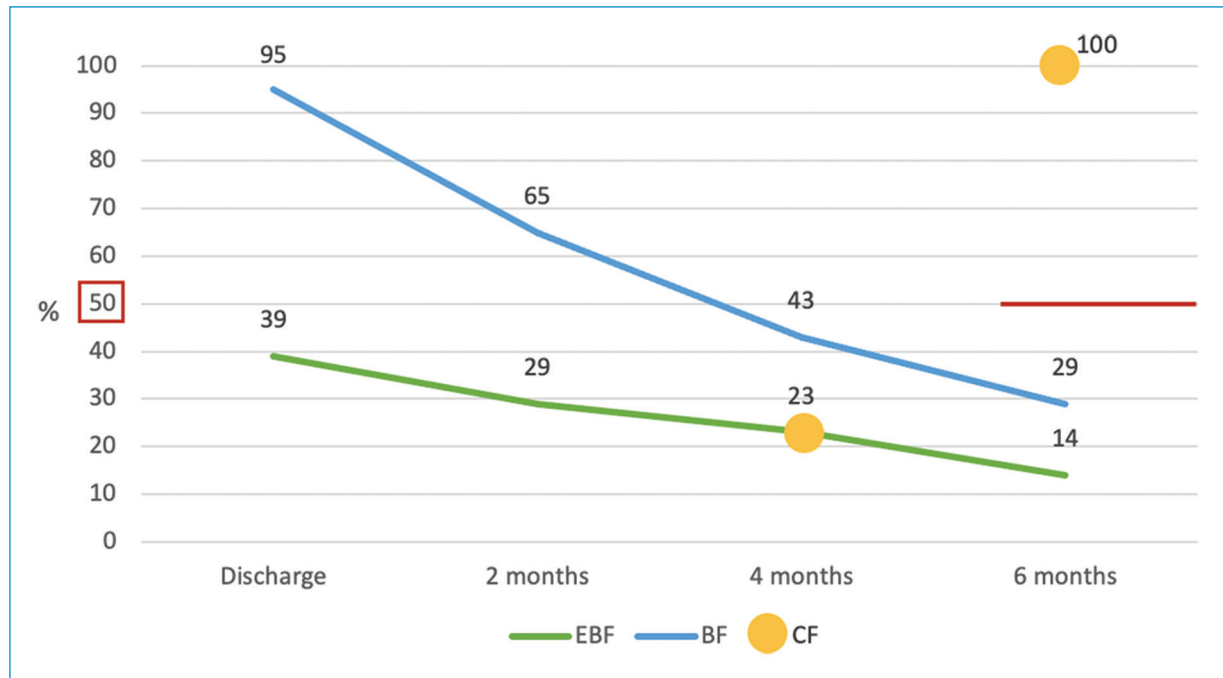


Figure 1. Evolution of exclusive breastfeeding and breastfeeding rates up to six months of age. EBF: exclusive breastfeeding; BF: breastfeeding; CF: complementary feeding.

Table 3. Comparative analysis of exclusive breastfeeding rate at discharge from the NICU and factors relating to the mother and pregnancy

	NICU discharge		
	EBF n (%)		p
	Yes 25 (39)	No 40 (61)	
Maternal age mean, years	29.1	32.2	0.020 [†]
Mother with higher education, n (%)	8 (32)	19 (48)	0.217*
European nationality, n (%)	22 (88)	34 (85)	0.987 [†]
Employed mother, n (%)	18 (72)	34 (85)	0.202*
Previous breastfeeding experience, n (%)	9 (36)	13 (33)	0.772*
Multiparous mother, n (%)	7 (28)	13 (33)	0.702*
Multiple pregnancy, n (%)	2 (5)	6 (24)	0.047 [‡]
Caesarean delivery, n (%)	16 (64)	23 (58)	0.603*

*Chi-squared test.

[†]Fisher's exact test.

[‡]Independent t-test

EBF: exclusive breastfeeding; NICU: Neonatal Intensive Care Unit.

of multiple pregnancies (0.047). Nevertheless, the limited number of cases of multiple pregnancies (two with exclusive breastfeeding and six without) is relevant and should prompt a careful interpretation of this finding.

No statistically significant differences were found regarding the mother's education or professional status, or prior breastfeeding experience. Similarly, no statistically significant differences were observed in factors related to the

Table 4. Comparative analysis of EBF at discharge from the NICU and factors relating to the newborn and the NICU stay

	NICU discharge		
	EBF n (%)		p
	Yes 25 (39)	No 40 (61)	
Sex, n (%)			
Female	15 (60)	20 (50)	0.431*
Male	10 (40)	20 (50)	
Birth weight mean, g	2267	2501	0.312 [‡]
Gestational age/weight relationship, n (%)			
Small for gestational age	1 (4)	5 (13)	0.393 [†]
Large for gestational age	1 (4)	3 (8)	0.889 [†]
Gestational age mean, weeks	34	35	0.412 [‡]
Need for surgery, n (%)	2 (8)	4 (10)	0.898 [†]
Length of stay median, days	17	10	0.335 [‡]
Skin-to-skin contact in the first hour, n (%)	11 (44)	15 (38)	0.603*
First contact with mother median, hours	4	2	0.141 [‡]
Donor human milk	5 (20)	6 (15)	0.308 [†]

*Chi-squared test.

[†]Fisher's exact test.[‡]Mann-Whitney U test.

EBF: exclusive breastfeeding; NICU: Neonatal Intensive Care Unit.

Table 5. Comparative analysis of exclusive breastfeeding at discharge from the NICU, two months and six months, in relation to a newborn weight of < 1500 g and a gestational age of < 32 weeks

	NICU discharge			2 months			6 months		
	EBF n (%)		p	EBF n (%)		p	EBF n (%)		p
	Yes	No		Yes	No		Yes	No	
Birth weight of < 1500g	9 (36)	5 (12.5)	0.025*	2 (10.5)	12 (26.1)	0.203 [†]	1 (11.1)	13 (23.2)	0.670 [†]
Gestational age of < 32 weeks	8 (32)	5 (12.5)	0.056*	1 (5.3)	12 (26.1)	0.087 [†]	1 (11.1)	12 (21.4)	0.674 [†]

*Chi-squared test.

[†]Fisher's exact test.

EBF: exclusive breastfeeding; NICU: Neonatal Intensive Care Unit.

newborns and the NICU stay, including birth weight, gestational age, main diagnosis, need for surgery, duration of hospitalization, skin-to-skin contact, and DHM use (Table 4).

When analyzing the type of breastfeeding at NICU discharge, two and six months, taking a newborn weight of < 1500 grams and a gestational age of < 32 weeks into account (Table 5), we found that the prevalence of exclusive breastfeeding at discharge was higher in newborns with a birth weight of < 1500 grams ($p = 0.025$). In a gestational age of < 32 weeks, we observed a

similar trend at the threshold of statistical significance (0.056). These links, however, were subsequently lost at two and six months.

Discussion

Despite breastfeeding being a priority in the NICU, exclusive breastfeeding rates tend to be low for hospitalized newborns¹⁵, failing to meet the WHO recommendations. In line with international literature, the prevalence of exclusive breastfeeding at discharge was

much lower than the latest national data published regarding maternity unit discharge figures for healthy newborns⁹. A 2019 study from the same department¹⁷ that investigated the prevalence of exclusive breastfeeding at maternity unit discharge and at two months in a population of healthy newborns reported rates of 80.5% and 59.7%, respectively.

In the population studied, no statistically significant differences were found concerning factors known to be associated with higher exclusive breastfeeding rates in healthy newborns, such as skin-to-skin contact, prior breastfeeding experience, or higher education status, a situation also noted in some international studies in the NICU^{11,15}.

Moreover, no statistically significant differences were found when comparing the reasons for NICU admission. However, in this study, prematurity and congenital anomalies, including cardiac and digestive anomalies requiring surgical correction in the neonatal period, accounted for 71% of the NICU admissions. Both of these conditions are potentially associated with added challenges to breastfeeding, but the literature on breastfeeding rates in relation to specific conditions requiring NICU admission is scarce, underscoring the need for further studies with larger samples.

According to a retrospective multicentric study involving Portuguese very preterm infants¹⁸, 25.2% of newborns < 32 weeks of gestational age were exclusively on breast milk at hospital discharge. These results are similar to our data (32%). We also found that the prevalence of exclusive breastfeeding at discharge was higher in newborns with a birth weight of < 1500 grams. These findings are in line with an international study in a level II NICU¹⁴ that also found better exclusive breastfeeding rates in premature infants at discharge, while gestational age did not significantly associate with exclusive breastfeeding rates during follow-up. The better rates of exclusive breastfeeding in smaller infants might be explained by NICU practices such as family-centered and neurodevelopment-focused care involving caregivers, which is particularly personalized to premature infants. It is also important to note that one of the criteria for DHM was a birth weight of < 1500 grams and the use of DHM instead of formula in this population might have served as a bridge to achieving exclusive breastfeeding at discharge. However, this study was not designed to address this matter and further studies are needed to clarify this.

The most relevant limitation of this study is the short recruitment period, leading to a small sample size. Further studies, both multicentric and with larger sample sizes, are needed to confirm these results and to

identify the determinants of breastfeeding success in newborns admitted to Portuguese NICUs. Moreover, an extension of this pilot study conducted to evaluate the impact of the implementation of the Human Milk Bank on breastfeeding rates could provide an important insight.

This study is the first prospective publication on exclusive breastfeeding rates up to six months of age in NICU-admitted newborns in Portugal, encompassing both medical and surgical admissions. These preliminary results are presented to highlight the need for improvement in NICU practices, extending beyond premature newborns, where more efforts are made to reinforce breastfeeding.

Previous presentation

51º Congresso Português de Neonatologia (23 – 24th November 2023).

Author contributions

S. Soares Cardoso: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. S. Catarino: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. S. Galdes Paulino: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. F. Flor-de-Lima: Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. S. Pissarra: Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. S. Costa: Conception and design of the study, report, review or other type of work or paper; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important

intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

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Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript

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