

Original Article

Maternal and Neonatal Factors Associated with Successful Breastfeeding in Preterm Infants

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Abstract

Background: The nutritional value and superiority of breast milk against the commercial infant formula has been confirmed by studies results, particularly for premature neonates.

Aims: The aims of this study was to: a) explore the factors that are significantly associated and affect the breastfeeding of preterm newborns after their exit from the Neonatal Intensive Care Unit (NICU) and during their stay at home and b) to explore the prevalence and duration of breastfeeding (exclusive or not) in the population of premature neonates in Greece.

Methodology: A cross-sectional study was conducted in 2014. A hundred mothers participated via telephone interviews in the study. The newborns of the above mothers were born prematurely and were hospitalized from 2009 to 2010 in a large public hospital pediatric NICU of Athens (Greece).

Results: The majority of the women were nulliparous, they had given birth by caesarean section (70%) and most of them had no previous experience of breastfeeding (65%). Just before leaving the NICU and during their stay at home, only 17% of the newborns were fed with exclusive breastfeeding and 24% received exclusively breast milk in any way. The main way of feeding was formula (54%). According to the multivariate logistic regression, breastfeeding at home after NICU discharge is strongly related to: a) mother's support for maintaining lactation ($p=0.026$), b) past experience of breastfeeding ($p=0.049$) and c) increased duration of pregnancy ($p=0.026$).

Conclusions: This research highlights factors that seem to have a significant impact on the decision of mothers of premature neonates to breastfeed, a crucial decision for this vulnerable category of newborns. In order to eliminate all obstacles that hinder the positive attitude of mothers towards breastfeeding, further exploration of relevant factors is necessary, in particular after the discharge of premature neonates from the NICU.

Key words: breastfeeding, NICU, preterm infant, duration, prevalence, after discharge

Introduction

Breast milk is considered the ideal food for neonates and infants (Lessen, Kavanagh, 2015; Arslanoglu et al., 2013; Agostoni et al., 2010; AAP, 2012). According to the American Society of Pediatrics, human milk is considered «unique» and the most suitable for the neonates, while all other breast milk substitutes are significantly lacking in value (AAP, 2012). Its nutritional value and superiority against the formula and its determining role mainly in protecting against infections and other illnesses for the neonate/infant and mother, has emerged through world literature and continues until today (Arslanoglu et al., 2013; Agostoni et al., 2010; AAP, 2012; Savino et al., 2013; Lessen, Kavanagh, 2015; Gura, 2014; Zhang et al., 2013). Considerable discussion has developed surrounding the undeniable positive effects of breast milk for premature babies. Breast milk is considered the best type of food for premature infants, since it has many protective factors for the underdeveloped gastro-intestinal system of premature neonates (hormones, antibodies, anti-inflammatory agents and enzymes) (Sullivan et al., 2010; Meinzen-Derr et al., 2009). Furthermore, it improves gastro-intestinal system mobility and contributes to bowel maturation and development of normal flora (Xu et al., 2017). The development of infection in a premature neonate makes him vulnerable to serious complications. Furthermore, the development of infections in Neonatal Intensive Care Units (NICU) is a painful daily reality that is responsible for the deaths of millions of premature newborns (Liu et al., 2012; Camacho-Gonzalez, Spearman, Stoll, 2013). Feeding with breast milk seems to create a natural "barrier" against neonatal infections and promotes neonatal survival. Specifically, in neonates receiving breast milk, lower rates of neonatal sepsis and necrotizing enterocolitis are recorded (Sullivan et al., 2010; Meinzen-Derr et al., 2009; Cortez et al., 2017). In addition, the incidence of acute otitis media, allergies, and respiratory infections, gastrointestinal and urinary infections is much lower (Underwood, 2013; Schanler, 2007). As a consequence, infants' hospitalization in the NICU is shorter (Maia et al., 2011). Recent studies have shown that breast milk mitigates a number of metabolic diseases, protecting particularly from obesity and type II diabetes (Savino et al., 2013; Oddy, 2012). At the same

time, compared to feeding with breast milk substitutes, breast milk feeding promotes improved nervous system development (Rozé et al., 2012) and function and final outcome of the preterm neonates. In particular, very low birth weight neonates fed with breast milk have, in general, better neurocognitive abilities in adulthood (Sammallahti et al., 2017). A decrease of mortality and long-term neurodevelopment disability has been recorded in preterm infants receiving breast milk (Shah et al., 2008). In addition, fewer readmissions in NICU have been recorded in these neonates, after leaving the NICU and during the first year of their life (Vohr et al., 2007). Although the advantages of breast milk and breastfeeding are unquestionable for premature babies according to the international literature, the hospitalization of a newborn in the NICU and the separation from its mother are significantly associated with reduced rates of breastfeeding initiation, lower frequency of breastfeeding (Pineda, 2011a; Demirci, Sereika, Bogen, 2013; Dodrill et al., 2008) and a shorter duration of breastfeeding after leaving the NICU compared with full-term neonates (Flacking, Wallin, Ewald, 2007; Perrella et al., 2012; Smith et al., 2015). The main obstacle for starting and maintaining breastfeeding of the premature neonate is the immaturity of its systems (respiratory, nervous and digestive). Furthermore, the premature neonate often presents disorders of cerebral development, abnormalities of muscle tone, impaired release of reflexes and reduced ability for thermoregulation (Sahni, Polin, 2013). At the same time, while premature neonates have high demands in energy and nutrients (Underwood, 2013), they present significant feeding difficulties by mouth due to lack of suck-swallow-breathe coordination, reduced intestinal motility, and decreased intestinal maturation and digestion capacity (Lau, 2006). All these difficulties (combined with the separation of the newborn from the mother and the decreased interaction and contact with her and with the breast) create many obstacles to breastfeeding of the preterm neonate, especially for the neonate born before 32 weeks of gestation. According to the literature, apart from the above obstacles, there are other factors that have been linked to breastfeeding of premature neonates and which seem to complicate further the initiation and maintenance of breastfeeding after leaving the NICU. These include practices in the NICU, birth weight of the neonate,

mothers' briefing, smoking, the contact and interaction with the mother, etc. (Ikonen, Paavilainen, Kaunonen, 2015; Pineda, 2011b; Zachariassen et al., 2010; Alves et al., 2013). These factors are largely responsible for premature neonates not taking breast milk and/or early termination of the exclusive breastfeeding. Considering the major benefits of breastfeeding for this vulnerable group, the identification of the above-mentioned factors in every society and culture, is a key issue for public health. The purposes of this study were: a) to identify and explore factors significantly associated and affecting the breastfeeding of preterm newborns after their discharge from the NICU and during their stay at home and b) to explore the prevalence and duration of breastfeeding (exclusive and not exclusive) of premature neonates. Considering the major benefits of breastfeeding for premature neonates and the sparse published data correlated to the above critical public health issues (Iliodromiti et al., 2018; Vassilaki et al., 2014; Dritsakou et al., 2017) in Greece, this study aims to identify and highlight the crucial factors which prevent breastfeeding of premature neonates. In the context of the community, the conclusions of this study will provide the basis for guidelines and interventions for the promotion of breastfeeding in premature neonates after their discharge from the NICU and during their stay at home.

Methodology

Population study: A cross-sectional study was conducted in 2014. During the period from 2009 to 2010, all mothers (n = 140) whose newborns had been hospitalized in a public Pediatric Hospital NICU of Athens were invited to take part in the study. Eventually, 100 women accepted to participate. That hospital is one of the largest purely pediatric hospitals in Greece and its NICU hospitalizes premature or abnormal neonates, which were born in obstetric departments of the same county or other counties of the country. Thus, it is possible that the parents of hospitalized neonates reside permanently in a large distance from the above-mentioned hospital. Neonatal death was considered the sole criterion for exclusion from the study.

Measures: Data were collected by telephone interviews. A structured questionnaire related to breastfeeding and breast milk feeding was distributed to the mothers during their stay at the

hospital and after their discharge. The questionnaire was based on the literature and it was conducted for the purposes of the present study. The pilot implementation of the questionnaire included 10 women who had given birth prematurely, a few months before 2009, and whose children were hospitalized in the same NICU of the same hospital. It was concluded that it was an intuitive questionnaire focused on the purposes of the study. It should be emphasized that, in all phases of the study, the ethics rules were followed. Initially, in order to have access to the files of the hospital's NICU, the related protocol was accepted from the Committee on Bioethics and Ethics of the hospital and the necessary approval to conduct the research was received in writing. At the same time, the Senior female Nurse and the Director of the NICU were informed. In the second phase, telephone interviews of the mothers were carried out, lasting approximately 45 minutes each. Initially, every mother has been briefed in detail on how the survey was conducted, the purposes of the study and compliance with the principles of anonymity and confidentiality of information. The interviews were started after the above mentioned «informed consent». In case that the mother wanted to participate but the time was not appropriate, another telephone interview was scheduled at the participant's convenience. This arrangement proved important in the final participation in the study. Independent variables defined as follows: a) sociodemographic characteristics of the mother as age, marital status, educational level, the country of origin, the annual family income, b) perinatal characteristics as the number of fetuses (one, ≥ 2), duration of pregnancy, medical problems during pregnancy (DB), smoking habit DB, place of birth (urban or rural area), mode of delivery (normal labor/cesarean section), previous breastfeeding experience, the intention for breastfeeding during pregnancy, support for breastfeeding after leaving the NICU, the return to work after childbirth, and c) neonatal characteristics including gender, birth weight, length of stay in the NICU, the need for mechanical ventilation (none, full, partial). Breastfeeding was studied as a dependent variable after home discharge (as described by the mothers/exclusive or non exclusive breastfeeding and/or feeding with expressed milk [exclusive or non exclusive]).

Statistical analysis: Data analysis was performed with the Statistical Package for Social Sciences (SPSS) 19.0. Categorical variables are presented as absolute numbers (n) and percentages, and quantitative variables are presented as mean and standard deviation of the mean. For quantitative variables, the *Kolmogorov–Smirnov test* verified the normality of the distribution. Student's *t-test* was used to investigate the relation between a quantitative variable and a dichotomous one. *Chi-square test* and *Fisher's exact test* were used to estimate the relation between two categorical variables. In case that two independent variables were found as statistically significant at the level of 0,2 ($p < 0,2$), multivariate logistic regression was used as backward stepwise linear regression (presenting *odds ratios*, *95% confidence intervals* and *p values*). *P values* under 0.05 were considered as statistically significant.

Results

Table 1 shows the socio-demographic characteristics of the mothers included in the study and perinatal and neonatal data. The mean age of the mothers was 33.2 years. Most of them were of Greek origin (83%) and married (96%), with a higher education level (54%) and a good annual income (for the Greek data). Thirty-two percent of the mothers gave birth in a region outside the Prefecture of Attica (in an obstetric department of a hospital not including the NICU of the hospitalized infant). The majority of the women had given birth by caesarean section (70%), most mothers had no previous experience of breastfeeding (65%), and a significant proportion of these had to return to work 40 days after birth (36%). Most of the hospitalized newborns were the first-born children (54%), boys (61%), with an average birth weight of 1950g, a mean duration of gestation of 33.1 weeks and a mean length of stay in the NICU of 34.2 days.

According to the Table 2, over one half of the hospitalized newborns (56%) were fed with formula and only 17% were fed with exclusive breastfeeding or exclusive breast milk (e.g. bottle, etc.) after discharge from the NICU. The first days at home, the newborns' feeding was only formula (54%). Exclusive breastfeeding or feeding only with breast-milk was noted in only 24% of the newborns during that period. The

mean duration of breastfeeding or feeding with breast-milk was 5.9 months.

According to the univariate analysis, breastfeeding at home (Table 3) seems to be related with maternal and neonatal factors. Maternal factors included intention (during pregnancy) to exclusive breastfeed ($p=0.003$), past experience of breastfeeding ($p=0.003$) and mother's health professional support after leaving the NICU ($p=0.02$). Neonatal factors included infant's birth weight ($p=0.01$) and the duration of hospitalization in NICU ($p=0.001$). According to the multivariate logistic regression (Table 4), breastfeeding at home was strongly related to: a) mother's support for maintaining lactation after NICU discharge ($p=0,026$), b) past experience of breastfeeding ($p=0,049$) and c) increased duration of pregnancy ($p=0,026$).

Discussion

As far as we know, this is the first retrospective study investigating the frequency and duration of breastfeeding, exclusively, in a population of preterm neonates during the interval from NICU hospitalization till the first weeks at home. The mean duration of gestation and NICU hospitalization were 33.1 weeks and 34.2 days respectively, while the mean infants' birth weight was 1950 g.

According to our data, exclusive breastfeeding or feeding with exclusive breast milk was achieved only in 12%, 17%, and 24% of preterm neonates during their stay in NICU, at their discharge from the NICU, and during the first days after return at home, respectively. Furthermore, breastfeeding rates (exclusive or partial) were low during NICU hospitalization (44%), at discharge from the NICU (48%), and during the first days at home (46%), with mean duration of breastfeeding the 5.9 months.

Our data show that the percentages of breastfeeding in premature neonates are quite low in Greece. Similarly, low incidence of breastfeeding is recorded in countries of South Europe, as Portugal (Rodrigues et al., 2017). On the contrary, in countries of North Europe, as Denmark (Zachariassen et al., 2010; Maastrup et al., 2014), the incidence of breastfeeding (exclusive or partial) is high in premature neonates.

Table 1. Mothers' and Infants' Characteristics

Mothers' sociodemographic characteristics	N (%)
Age	33.2 (5.1) ^a
Marital status	
Married	96 (96.0)
Single	4 (4.0)
Educational level	
12 years and less	46 (46.0)
More than 12 years	54 (54.0)
Country of origin	
Greece	83 (83.0)
Except Greece	17 (17.0)
Annual family income (euro)	24.406 (13.452) ^a
Perinatal characteristics	
Smoking during pregnancy	
Yes	14 (14.0)
No	86 (86.0)
Daily number of cigarette	8 (5.5) ^a
Place of birth	
Urban area	68 (68.0)
Semi-urban or rural area	32 (32.0)
Type of childbirth	
Normal	30 (30.0)
Caesarian section	70 (70.0)
Breastfeeding experience	
Yes	35 (35.0)
No	65 (65.0)
Return to work, after birth	
Non-return due to unemployment	60 (60.0)
Return within the first 40 days of childbirth	4 (4.0)
Return after the first 40 days of childbirth	36 (36.0)
Infants' characteristics	
Sex	
Male	61 (61.0)
Female	39 (39.0)
Child's series	
First	54 (54.0)
Second	31 (31.0)
Third	15 (15.0)
Birth weight (g)	1950 (657.4) ^a
Duration of destination (weeks)	33.1 (2.9) ^a
Duration of staying in NICU (days)	34.2 (30.8) ^a

^a Average (St. Deviation)

Table 2. Feeding's patterns of preterm newborns during and after discharge from NICU

Characteristic	N (%)
Feeding in NICU	
Exclusive Breastfeeding or exclusive breast milk	12 (12.0)
Breast milk and formula	32 (32.0)
Exclusive formula	56 (56.0)
Feeding at discharge from NICU	
Exclusive Breastfeeding or exclusive breast milk	17 (17.0)
Breast milk and formula	31 (31.0)
Exclusive formula	52 (52.0)
Feeding at home	
Exclusive Breastfeeding or exclusive breast milk	24 (24.0)
Breast milk and formula	22 (22.0)
Exclusive formula	54 (54.0)
Breastfeeding duration or duration of giving breast milk (months)	5.9 (6.7) ^α

α Average (St. Deviation)

Table 3. Factors related with preterm newborns' breastfeeding at home

Mother's characteristics	Breastfeeding at home		p
	No	Yes	
Marital status			0.99 ^α
Married	74 (77.1)	22 (22.9)	
Single	3 (75.0)	1 (25.0)	
Educational level			0.93 ^β
Primary school graduate	13 (81.3)	3 (18.7)	
High school graduate	22 (73.3)	8 (26.7)	
University graduate	42 (77.8)	12 (22.2)	
Country of origin			0.99 ^α
Greece	64 (77.1)	19 (22.9)	
Except Greece	13 (76.5)	4 (23.5)	
Place of birth			0.5 ^α
Urban	51 (75.0)	17 (25.0)	
Semi-urban or rural	26 (81.3)	6 (18.8)	
Age (years)	32.1 (5.3)	33.5 (5.0)	0.3 ^γ
Annual family income (euro)	25.043 (13.854)	24.205 (13.415)	0.8 ^γ
Duration of gestation (weeks)	32.9 (2.9)	34.1 (2.4)	0.07 ^γ
Pregnancy			0.3 ^β
Single	52 (74.3)	18 (25.7)	
Twins	21 (80.8)	5 (19.2)	
Multiples	4 (100.0)	0 (0.0)	
Smoking in pregnancy			0.2 ^α

No	64 (74.4)	22 (25.6)	
Yes	13 (92.9)	1 (7.1)	
Health problems in pregnancy			0.7 ^a
No	60 (77.9)	17 (22.1)	
Yes	17 (73.9)	6 (26.1)	
Intention for			0.003^a
Exclusive breastfeeding	37 (64.9)	20 (35.1)	
Breastfeeding and formula	10 (76.9)	3 (23.1)	
Exclusive formula	10 (100.0)	0 (0.0)	
I hadn't decide	20 (100.0)	0 (0.0)	
Type of birth			0.3
Normal	25 (83.3)	5 (16.7)	
Caesarian section	52 (74.3)	18 (25.7)	
Breastfeeding experience			0.003^a
No	56 (86.2)	9 (13.8)	
Yes	21 (60.0)	14 (40.0)	
Healthcare professional's support after discharge			0.02^a
No	66 (82.5)	14 (17.5)	
Yes	11 (55.0)	9 (45.0)	
Return to work after birth			0.4 ^a
Non-return due to unemployment	49 (81.7)	11 (18.3)	
Return within first 40 days from birth	3 (75.0)	1 (25.0)	
Return after 40 days from birth	25 (69.4)	11 (30.6)	
Infant's characteristics			
Sex			0.6 ^a
Male	48 (78.7)	13 (21.3)	
Female	29 (74.4)	10 (25.6)	
Birth weight (g)	1860 (634)	2251 (656)	0.01^γ
Duration of staying in NICU (days)	38.3 (32.7)	20.3 (18.0)	0.001^γ
Infant's respiratory support			0.9 ^β
None	36 (78.3)	10 (21.7)	
Partial	9 (69.2)	4 (30.8)	
Full	32 (78.0)	9 (22.0)	

^{a, β} χ^2 test, ^γ t-test

Table 4. Multivariate logistic regression with breastfeeding at home as independent variable

	<i>Odds ratios</i>	<i>95% confidence intervals</i>	<i>p</i>
Gestational duration	0.97	0.94 έως 0.99	0.026
Breastfeeding experience in relation to non breastfeeding experience	3.2	1.02 έως 10.9	0.049
Healthcare professional's support to mother after infant's discharge from NICU in relation to absent of similar support	4.4	1.2 έως 16.4	0.026

Recently, the Institute of Child Health and the National School of Public Health published a national study related to the frequency and determining factors of breastfeeding in Greece (Iliodromiti et al., 2018). In comparison with older data (ten years ago), hopeful messages of this study include the significant increase in the rate of breastfeeding during the first six months (Gaki et al., 2009). However, the levels of exclusive breastfeeding in all neonates, and the levels of breastfeeding (exclusive and not exclusive) in particular groups (including preterm neonates, low birth weight neonates, and those hospitalized in NICU) were extremely low.

Specifically, according to this national study (Iliodromiti et al., 2018), only 53.6% of newborns in the NICU breastfed (exclusively and not exclusively), i.e. a percentage similar to that of the present study. Also, at the end of the first month after birth, only 23.5% of premature babies were exclusively breastfed (similarly with the present study). In particular, percentages of exclusive breastfeeding were 18.2% and 7.7% for newborns with low birth weight less than 2500g and newborns with birth weight less than 2000g respectively (Iliodromiti et al., 2018). In a Greek prospective mother-child cohort study in Crete ('Rhea' study) (Vassilaki et al., 2014), investigating the duration of breastfeeding in a sample of 1208 infants, breastfeeding was recorded in only 11.8% of premature neonates and only 14.1% of those who had been hospitalized in the NICU. Accordingly, from the recent national study and similar Greek surveys, as well as from the present study, a worrying picture is recorded about the levels of exclusive breastfeeding in the population of premature babies in Greece.

The data that highlights this research, in relation to the level of breastfeeding of preterm newborns in Greece, are very interesting. However, at the same time, these data, combined with the policy implemented in NICUs, cause particular concern. Compared with other NICUs in the country (maintaining specific visiting hours, in which parents are invited to adapt), the NICU in which this survey was conducted is one of the few (if not the only public NICU) that allows parents to visit the newborn 24 hours a day (a family – NICU's friendly environment). This positive "particularity" of this NICU contributes to the reduction of the "natural" mother's distance from the hospitalized and premature neonate to a

considerable extent and thus it removes a significant barrier to initiation and installation of breastfeeding (Alves et al., 2016).

According to global literature (Alves et al., 2016; Cuttini et al 2019), policies allowing parents' visitation 24 hours per day in a family-friendly environment could increase breastfeeding rates of premature newborns in the NICU. However, it is alarming that the level of breastfeeding is actually the same comparing the findings of this study (in a NICU that places no restrictions on visiting parents) with those of the national survey for breastfeeding (with NICUs' sample from all over the country, having specific visiting hours for parents; with very few exceptions).

It is worth to note that in this study approximately half of mothers (48%) had taken medication, immediately after childbirth or after the introduction of the newborn in the NICU, in order to inhibit lactation. Obviously, half of the mothers did not have the opportunity to benefit from the policy of «open» NICU, considering that weaning was started quite early. Future research should explore the factors governing the Greek mothers towards the inhibition of lactation immediately after the premature birth and to what extent this is a conscious choice of the mother or the result of other factors such as incomplete prenatal counseling and education of parents on breastfeeding, the long distance of residence from the hospital, the transportation of the premature infant in another hospital from what was born, NICU policies etc.

According to this survey, the support that mother receives at home ($p=0,026$), the previous breastfeeding experience ($p=0,049$) and the duration of pregnancy ($p=0,026$) represent the three determinants which significantly have an affect on the mothers' premature neonates decision for breastfeeding after leaving the NICU and returning home. Specifically, the women who received support for the preservation of lactation, after newborn's discharge from the NICU, breastfed 4.4 times more frequently compared with other women ($p=0.026$). Similarly, women with previous breastfeeding experience breastfed 3.2 times more frequently ($p=0.049$). From the international literature, all three above factors have emerged as quite important for the promotion of breastfeeding in both premature and term neonates (Craighead, Elswick, 2014; Tavoulari et al., 2015; Bai, Fong, Tarrant, 2015; Wang et al., 2019; Ericson,

Flacking, Udo, 2017). All three above factors have emerged from the international literature as quite important for the promotion of breastfeeding in both premature and term neonates. According to a recent review (Briere et al., 2014), some other factors, including kangaroo care method and the prenatal education of parents on breastfeeding, seem to affect the duration of breastfeeding of premature neonates after their discharge from NICU.

In Greece, the last decade, significant strides have been made to promote breastfeeding on institutional and societal level. The reopening of the National Commission on Breastfeeding and the programme «Alkyoni: national initiative to promote breastfeeding» (co-financed by the European Social Fund and the Ministry of health) resulted to the acquisition of 4 infant-friendly hospitals in Greece. Further results include the creation of spaces for breastfeeding in the community/workplaces, a telephone support line, etc. Legal regulations and ministerial decisions, circulars and guidelines for health professionals, NGOs (active in the perinatal field) implementing supportive breastfeeding interventions (in the peripartum period) and mothers groups initiatives helped to create a very optimistic climate for breastfeeding. According to the recent national study (Iliodromiti et al., 2018), all the above contributed to obvious changes of mothers desire and behavior towards breastfeeding. However, these encouraging changes must be assisted with greater efforts to inform and support the mothers, especially in critical and sensitive periods, such as the time of hospitalization of newborns in the NICU.

Conclusion: This research confirms the existence of significant barriers against breastfeeding in non-term pregnancies requiring neonatal hospitalization in NICU due to prematurity. The extremely low rates of premature babies breastfeeding in Greece imposes specific measures to protect this vulnerable group of neonatal population. The factors that emerge from this survey and which largely determine the rate and duration of breastfeeding in premature neonates should be taken into account in order to create the appropriate guidelines and recommendations in relation to breastfeeding of premature neonates after their discharge from the NICU and during their staying at home. Every society that respects the women's rights and the newborn health must

take seriously the factors that undermine breastfeeding in a vulnerable population group, as is that of premature babies.

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