Original Article

Factors associated with exclusive breastfeeding in low birth weight infants at NICU discharge and the start of complementary feeding

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The aim of the present study was to clarify clinical factors in low birth weight infants and their mothers associated with exclusive breastfeeding at both neonatal intensive care unit (NICU) discharge and the start of complementary feeding. One hundred and fifteen low birth weight children and 98 mothers attending the follow-up clinic of two tertiary NICUs in Nara prefecture (Japan), between June and September, 2011, were enrolled. The relationship between the feeding categories at NICU discharge or the start of complementary feeding, and clinical factors of the mothers and low birth weight infants collected by either their charts or a face-to-face interview was analyzed. The prevalence of exclusive breastfeeding was 22.6% at NICU discharge, and 15.7% at the start of complementary feeding. In logistic analysis, exclusive breastfeeding at NICU discharge was associated with mother's younger age at delivery and an earlier start of oral nutrition. Among 26 exclusively breast-fed infants at NICU discharge, fifteen infants (57.7%) were still being exclusively breast-fed at the start of complementary feeding. In low birth weight infants, a shorter stay at NICU and an earlier start of oral nutrition were associated factors with exclusive breastfeeding at the start of complementary feeding. None of maternal factors were found to be associated with exclusive breastfeeding at the start of complementary feeding. Conclusively, starting of oral nutrition as early as possible is thought to be crucial for introducing exclusive breastfeeding in low birth weight infants both at NICU discharge and the start of complementary feeding.

Key Words: breastfeeding, low birth weight infants, NICU, interview, complementary feeding

INTRODUCTION

The nutritional, immunologic, developmental, psychological, social, economic and environmental advantages of breastfeeding have been well documented.[1] Because of this notion, pediatric societies in various countries recommend breastfeeding.[1-3] In addition, the World Health Organization (WHO), in collaboration with the United Nations Children's Fund (UNICEF), have established ten steps for promoting and supporting breastfeeding.[4] For low birth weight (LBW) infants, the benefits of breastfeeding are thought to be more distinct.[5-7] Several investigators reported that the use of breast milk in LBW infants decreased the risk of serious infections[8,9] and necrotizing enterocolitis,[10] and improved motor or mental development.[11] However, LBW infants have an immature capability of directly sucking from the breast.[12] In addition, isolation of LBW infants from their mothers in the neonatal intensive care unit (NICU) is an obstacle to providing the infants with a constant and sufficient supply of breast milk. Therefore, pediatricians and NICU caregivers try to implement strategies for promoting breastfeeding to mothers both during NICU hospitalization and after NICU discharge.[13,14] The purpose of the present study is to delineate the maternal and infant clinical factors associated with exclusive breastfeeding at two different stages, i.e., NICU discharge and the start of complementary feeding.

MATERIALS AND METHODS

Study population

Ninety-eight mothers and their 115 LBW children who attended the follow-up clinic for LBW children at either Nara Medical University Hospital or Nara Prefectural NARA Hospital between June and September, 2011, were enrolled. The NICUs at these two hospitals are tertiary facilities caring for more than 95% of the LBW infants born in Nara Prefecture, Japan. Of note is that these hospitals belong to "The Baby-Friendly Hospital" proposed by WHO and UNICEF.[15] The NICU staffs at these hospi-

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Manuscript received 22 October 2012. Initial review completed 25 December 2012. Revision accepted 15 January 2013.
doi:10.6133/apjcn.2013.22.2.11

tals do a good job promoting exclusive breastfeeding in LBW infants through education and support of their mothers. Infants with exterior hospital birth, severe congenital anomalies, severe neurological sequelae, chromosome abnormalities and receiving home infusion therapy were excluded in advance. The median and range of chronological and corrected age of the infants at the time of investigation were 21 months (7-81 months) and 18 months (5-77 months), respectively. The median and range of the chronological and corrected age of the infants at the start of complementary feeding were 7 months (5-14 months) and 5 months (2-12 months), respectively.

Data collection

We retrospectively investigated the charts of 115 LBW infants during admission at the two NICUs to collect clinical factors, including the pregnancy history of their mothers. To obtain information on the feeding categories, the chief investigator (KM) carried out a face-to-face interview with the mothers at the follow-up clinic after the chief physicians' and mothers' consent. Only several of the mothers whose infants fulfilled the criteria described above refused to participate in the interview. The questions asked in the interview were; 1) feeding category at NICU discharge; 2) chronological and corrected age at the start of complementary feeding; and 3) feeding category at the start of complementary feeding. This study was approved by the ethical committee for epidemiological study at Nara Women's University.

Definition of feeding categories

In the present study, breastfeeding was defined as "exclusive" breastfeeding using the WHO definition.[16] Both expressed and fortified breast milk were categorized as breast milk. Bottle feeding was defined as any type of formula milk without any breast milk. When infants took both breast and formula milk, the feeding category was classified as mixed feeding regardless of their ratio.

Statistics

In the following analysis, we divided the whole participants into two groups; i.e., breastfeeding and mixed plus bottle feeding. For univariate analysis, comparison of categorical or continuous variables in the two groups was carried out by chi-square test or Mann-Whitney U test, respectively. In the logistic analysis, if the participants were positive in the categorical factors listed in the tables, then the number "1" was allocated, if not, the number "0" was allocated. All statistical analyses were carried out using "Excel Statistics, Version 2007". A p value of less than 0.05 was considered statistically significant.

RESULTS

Comparison of clinical factors in mothers and their LBW infants between the two hospitals

First, we compared various clinical factors of the mothers and their LBW infants in the two hospitals. As indicated in Table 1, there were no statistically significant differences in these clinical factors between the two hospitals. Therefore, we concluded that it would be valid to combine the data of the two hospitals together in the following analysis.

Factors associated with exclusive breastfeeding at NICU discharge

Table 2 depicts various factors in relation to breastfeeding at NICU discharge. The overall prevalence of breastfeeding in LBW infants was 22.6%. With regards to the maternal factors, univariate analysis demonstrated that a younger age at delivery was significantly associated with breastfeeding. In the LBW infants, an earlier starting date of oral nutrition or cot transfer from an incubator was associated with breastfeeding. In the logistic analysis carried out using 4 maternal factors or 10 infant factors separately, younger age of mothers at delivery and earlier starting date of oral nutrition revealed a significant association with breastfeeding.

Changes of feeding categories from NICU discharge to the start of complementary feeding

Among 26 breast-fed infants at NICU discharge, fifteen infants were still being breast-fed at the start of comple-

Table 1. Comparison of clinical factors in mothers and infants between the two hospitals

	All	Nara Medical University	Nara Prefectural Hospital	p values
Maternal factors				
n	98	50	48	
Breastfeeding§	24 (24.5)†	12 (24.0)	12 (25.0)	0.91
Age at delivery (years) ¶	31 [17-42]‡	31 [23-42]	32 [17-38]	0.24
Previous parity§	48 (49.0)	28 (56.0)	20 (41.7)	0.16
Caesarean section§	67 (68.4)	35 (70.0)	32 (66.7)	0.72
Pregnancy hypertension§	22 (20.4)	14 (28.0)	8 (16.7)	0.18
Infant factors				
n	115	56	59	
Breastfeeding§	26 (22.6)	12 (24.0)	14 (23.7)	0.77
Male§	71 (61.7)	35 (70.0)	36 (61.0)	0.87
Singleton§	74 (64.3)	39 (69.6)	35 (59.3)	0.25
Gestational period (weeks) ¶	32.6 [23.3-40.9]	32.5 [23.3-40.9]	32.7 [24.3-38.3]	0.39
Birth weight (gr) ¶	1604 [426-2432]	1675 [426-2432]	1532 [634-2387]	0.41
Apgar score (1 min) ¶	7 [1-9]	7 [1-9]	8 [1-9]	0.66
Respiratory distress syndrome§	45	22 (39.3)	23 (39.0)	0.97

† Numbers in parentheses indicate percentages.
‡ Means and ranges (in brackets) are shown.
§ Chi-square test, ¶ Mann-Whitney U test.

Table 2. Comparison of clinical characteristics between breastfeeding and mixed/bottle feeding at NICU discharge

	Breastfeeding	Mixed/Bottle feeding	*p* values	Odds ratio††	95% CI
Maternal factors					
n	24 (24.5)†	74 (75.5)			
Age at delivery (years) ¶	29 [24-38]‡	32 [17-42]	0.024*	0.94	0.81 - 0.98
Previous parity§	12 (50.0)	36 (48.6)	0.91	1.16	0.44 - 3.04
Caesarean section§	14 (58.3)	53 (71.6)	0.22	0.68	0.25 - 1.87
Pregnant hypertension§	5 (20.8)	17 (23.0)	0.83	1.02	0.32 - 3.29
Infant factors					
n	26 (22.6)	89 (77.4)			
Male§	18 (69.2)	53 (59.6)	0.37	0.84	0.29 - 2.42
Singleton§	19 (73.1)	55 (61.8)	0.29	1.08	0.74 - 1.38
Gestational period (weeks) ¶	32.6 [25.3-36.1]	32.7 [23.2-40.9]	0.78	0.79	0.54 - 1.17
Birth weight (gr) ¶	1628 [426-2406]	1549 [538-2432]	0.22	1.01	0.98 - 1.03
Apgar score (1 min) ¶	8 [3-9]	7 [1-9]	0.31	1.19	0.87 - 1.63
Respiratory distress syndrome§	11 (42.3)	35 (39.3)	0.78	2.02	0.49 - 4.38
Duration of admission (days) ¶	40.5 [19-151]	45 [14-223]	0.34	0.99	0.95 - 1.12
Staring date of oral nutrition¶	9.5 [1-105]	12 [1-143]	0.046*	0.90	0.84 - 0.97
Date of cot transfer¶	15 [4-107]	16.5 [2-99]	< 0.01*	1.03	0.95 - 1.12
Duration of oxygen administration (days) ¶	4 [0-75]	4.5 [0-193]	0.71	0.98	0.92 - 1.03

† Numbers in parentheses indicate percentages.
‡ Means and ranges (in brackets) are shown.
§ Chi-square test, ¶ Mann-Whitney test
†† Logistic analysis (Breastfeeding; 1, Mixed/Bottle feeding; 0)
**p* values are significantly different.

Table 3. Changes in the pattern of feeding categories from NICU discharge to the start of complementary feeding

	Discharge†	Start of complementary feeding	n‡
Feeding categories	Breastfeeding (26)	Breastfeeding	15 (13.0)
		Mixed feeding	11 (9.6)
		Bottle feeding	0 (0)
	Mixed feeding (50)	Breastfeeding	3 (2.6)
		Mixed feeding	47 (40.9)
		Bottle feeding	0 (0)
	Bottle feeding (39)	Bottle feeding	39 (33.9)

† Numbers in parentheses indicate the number of LBW infants.
‡ Numbers in parentheses indicate the percentages of total LBW infants (n=115).

mentary feeding. Three infants with mixed feeding were found to have moved to the breastfeeding group. Thus, eighteen infants were breast-fed at the start of complementary feeding (Table 3). Notably, all infants who were bottle-fed at NICU discharge remained in the bottle feeding group at the start of complementary feeding.

Factors associated with exclusive breastfeeding at the start of complementary feeding

None of 4 maternal factors including mother's age at delivery were associated with breastfeeding by either univariate or logistic analysis (Table 4). In contrast, higher birth weights, shorter hospital stay or oxygen administration, and an earlier start date of oral nutrition or cot transfer from an incubator were significantly associated with breastfeeding by univariate analysis. After adjusting these factors by logistic analysis, shorter hospital stay and earlier starting date of oral nutrition remained associated factors.

DISCUSSION

Breastfeeding, especially exclusive breastfeeding, is potentially important for promoting the health of both normal and LBW infants. WHO and UNICEF recommend and propel the policy of exclusively breastfeeding for the first 6 months of life.[16] In consequence, the prevalence of exclusive breastfeeding among infants younger than 6 months in the developing countries increased from 33% in 1995 to 39% in 2010.[17] In the investigation of Japanese normal infants in 2010, the prevalence of exclusive breastfeeding at 1 month and 3 three months was 51.6% and 56.8%, respectively.[18] However, the prevalence of exclusive breastfeeding in LBW infants is still not satisfactory. Therefore, investigating the obstacles for breastfeeding in LBW infants is one of the central issues in perinatology.[19] The results of previous reports on this issue were quite diverse depending on the study designs; i.e. study population (LBW or very LBW (VLBW), definition of breastfeeding (exclusive or partial), time of investigation of the nutritional method (NICU discharge

Table 4. Comparison of clinical factors between breastfeeding and mixed/bottle feeding at the start of complementary feeding

	Breastfeeding	Mixed/Bottle feeding	*p* values	Odds ratio ††	95% CI
Maternal factors					
n	17 (17.3)†	81 (82.7)			
Age at delivery (years) ¶	31 [24-38]‡	32 [17-42]	0.18	0.94	0.84 - 1.06
Previous parity§	8 (47.1)	40 (49.4)	1.00	0.89	0.29 - 2.65
Caesarean section§	9 (52.9)	58 (71.6)	0.16	0.51	0.16 - 1.53
Pregnancy hypertension§	3 (17.6)	19 (23.5)	0.76	0.80	0.19 - 3.22
Infant factors					
n	18 (15.7)	97 (84.3)			
Male§	12 (66.7)	59 (60.8)	0.79	0.62	0.17 - 2.27
Singleton§	15 (83.3)	59 (60.8)	0.11	1.02	0.78 - 1.26
Gestational period (weeks) ¶	34.2 [29.6-38.3]	32.1 [23.3-40.8]	0.085	0.71	0.44 - 1.16
Birth weight (gr) ¶	1769 [1094-2406]	1546 [426-2432]	0.021*	1.00	0.99 - 1.01
Apgar score (1 min) ¶	8 [4-9]	7 [1-9]	0.17	1.26	0.87 - 1.82
Respiratory distress syndrome §	4 (22.2)	41 (42.3)	0.12	1.00	0.17 - 3.82
Duration of admission (days) ¶	32.5 [15-84]	49 [14-223]	0.0088*	0.96	0.94 - 0.98
Starting day of oral nutrition ¶	2 [1-43]	16 [1-143]	0.018*	0.86	0.76 - 0.94
Date of cot transfer ¶	10 [4-44]	18 [2-126]	0.026*	1.11	0.98 - 1.26
Duration of oxygen administration (days) ¶	2.5 [0-20]	5 [0-193]	0.022*	0.92	0.80 - 1.06

† Numbers in parentheses indicate percentages.
‡ Means and ranges (in brackets) are shown.
§ Chi-square test, ¶ Mann-Whitney U test
†† Logistic analysis (Breastfeeding; 1, Mixed/Bottle feeding; 0)
* *p* values are significantly different

or a follow-up survey after NICU discharge), and other factors (clinical or socioeconomic), etc.[20-28]

We planned the present study to further delineate this issue with paying special attention to the following three points. Firstly, we defined breastfeeding as "exclusive breastfeeding", since WHO strongly recommends exclusive breastfeeding during the first 6 months of life.[16,29] Secondly, we investigated the prevalence of breastfeeding and its associated clinical factors at both NICU discharge and the start of complementary feeding. The longer duration of breastfeeding, presumably up to the time of complementary feeding, is thought to be ideal.[30] Finally, the collection of data on the feeding categories was done in-depth to minimize room for recall bias by a single interviewer using a face-to-face method.

In the present study, the prevalence of exclusive breastfeeding was 22.6% at NICU discharge and 15.7% at the start of complementary feeding. These values are slightly higher or lower than the recent Japanese or Italian studies in a large LBW cohort,[20,27] respectively. It is notable that 15 out of 26 exclusively breast-fed infants at NICU discharge (57.7%) continued exclusive breastfeeding, whereas only 3 out of 50 partially breast-fed infants (6.0%) were found to have been shifted to exclusive breastfeeding soon after NICU discharge. The prevalence of exclusive breastfeeding for VLBW infants at NICU discharge was reported to be 11.4-30.5% in various countries.[23,25,28] When mixed feeding was included in the definition of breastfeeding, the prevalence increased up to 61.1%, as in the study of 6790 VLBW infants born in California during 2005 and 2006.[26] In contrast, there are a limited number of longitudinal nutritional studies from NICU discharge to the start of complementary feeding. Flacking *et al* [22] reported that the rates of breastfeeding (exclusive or partial) were found to decrease with time, i.e. 79% at 2 months, 62% at 4 months, 45% at 6 months, and 22% at 9 months. This same tendency was also seen in the present study, demonstrating the need to continue to provide the supports for breastfeeding after NICU discharge.

In the large scale analysis of factors associated with exclusive breastfeeding in normal infants (including 8.5% LBW infants), Kaneko *et al* reported that age of mothers at 20-29 years, female, and singleton were associated with higher rate of exclusive breastfeeding.[20] However, the review based on Japanese studies on the topic failed to find any clear association between maternal age and exclusive breastfeeding.[18] The present study indicates that the date of starting oral feeding (both NICU discharge and the start of complementary feeding), younger maternal age at delivery (NICU discharge), and the length of NICU stay (the start of complementary feeding) were significant determinants of exclusive breastfeeding after adjustment of several clinical factors. Association of length of NICU stay has been documented in previous reports of VLBW infants from Austria and Brazil.[24,25] Kirchner *et al* speculated that it is difficult for mothers to supply babies who have a longer hospital stay with a sufficient amount of milk.[24] With regard to parity, we did not find any association, but previous studies found a conflicting influence on breastfeeding, ie, a positive[26] or negative[20] influence of multiple births. In contrast, Flacking *et al* demonstrated that socioeconomic factors such as maternal education, income and social welfare were more important determinants for the continuation of breastfeeding than clinical factors such as degree of prematurity and body weight at birth.[22]

This study has several limitations. As mentioned in the previous report, there is a wide variety of prevalence and characteristics in exclusive breastfeeding in LBW

infants among different NICUs.[23,27] Since only two NICU facilities were enrolled in the present study, further studies enrolling more NICU facilities is needed. Secondly, the socioeconomic status of the mothers, one of the important determinants for breastfeeding,[22] was not investigated. However, this information is very difficult to obtain in Japan at present, because of legal restriction on obtaining personal information. Finally, although each mother was interviewed by a single interviewer for over half an hour, the possibility of recall bias could not be fully excluded. A further prospective study should be planned to minimize the effect of the recall bias.

In spite of these limitations, the present study has highlighted two important issues. Firstly, early introduction of oral feeding is mandatory for accomplishing exclusive breastfeeding not only at NICU discharge, but also at the start of complementary feeding. Secondly, the fact that 11 out of the 26 infants (42.3%) who were exclusively breast-fed initially shifted to be partially breast-fed shortly after NICU discharge indicates that it is difficult for mothers of LBW infants to maintain exclusive breastfeeding for more than several months, although WHO recommends exclusive breastfeeding for the first 6 months.[29] With these facts in mind, physicians and NICU caregivers should establish a comprehensive system with the goal of achieving exclusive breastfeeding up until the complementary feeding.[31]

AUTHOR DISCLOSURES

The authors declare no conflict of interest.

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Original Article

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從新生兒加護病房出院及開始副食品餵食之際以全母乳哺餵低出生體重嬰兒之相關因素

本研究之目的，為探討從新生兒加護病房出院及開始副食品餵食時，以全母乳哺餵之低出生體重嬰兒及其母親之臨床因素。從 2011 年 6 月至 9 月之間，在日本奈良縣兩間具有三級設備之新生兒加護病房的醫院，共召募來看追蹤門診的低出生體重嬰兒 115 位及 98 位母親。從新生兒加護病房出院或開始餵食副食品時之哺餵型態與母親及低出生體重嬰兒之臨床因素資料，是藉由兒童生長圖表或是一對一面訪蒐集。全母乳哺餵的盛行率，在新生兒加護病房出院時，及開始餵食副食品之際，分別為 22.6%及 15.7%。邏輯斯迴歸分析顯示，新生兒加護病房出院時以全母乳哺餵與母親生產年齡較低及較早的口服營養相關。從新生兒加護病房出院時以全母乳哺餵的 26 位嬰兒中，有 15 位在副食品餵食開始之際仍以全母乳哺餵。在新生兒加護病房住院時日較短及較早的口服營養之低出生體重嬰兒，有較高比例在開始副食品餵食時仍接受全母乳哺餵。母體因素與開始餵食副食品時是否以全母乳哺餵，兩者間並無顯著相關。總結而論，儘早開始口服營養，為低出生體重嬰兒無論在新生兒加護病房出院時或是開始副食品餵食之際，以全母乳哺餵的決定性因素。

關鍵字：母乳哺餵、低出生體重嬰兒、新生兒加護病房、面訪、副食品餵養