Chapter

Premature Infant Care and Feeding

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Abstract

The burden of premature birth is still high worldwide at 10.6% and ranges from 5 to 18% of all babies born. About 80% of these occur in Africa and South Asia. In Sub-Saharan Africa, the burden ranges from 3.4 to 49.4%. In almost all countries, premature birth rates are on increase, which poses a threat to newborn health. Premature babies usually present with complications that hinder their ability to feed. Due to this, premature babies are at risk of insufficient nutrient supply, leading to undernutrition, failure to thrive and early newborn deaths. However, improved newborn feeding can avert these deaths. In line with this noble cause, this chapter focused on care and feeding of premature babies in hospital and home settings, feeding development, feeding difficulties, and growth and development monitoring for premature babies.

Keywords: premature, infant, nutrition, care, feeding

1. Introduction

A premature baby is one who is born alive before 37 weeks of pregnancy [1, 2]. The burden of premature birth is still high worldwide at 10.6% and ranges from 5 to 18% of all babies born [2]. About 80% of these occur in Africa and South Asia [1, 3]. In Sub-Saharan Africa, the burden ranges from 3.4 to 49.4% [4] and is highest in Malawi with 18.1 premature births per 100 births, Comoros (16.7), Congo (16.7), Zimbabwe (16.6), Equatorial Guinea (16.5), Mozambique (16.4), Gabon (16.3), and Mauritania (15.4) [1]. Recent demographic and health surveys of Sub-Saharan African countries showed that Eastern Africa and Southern Africa as well were likely to register high premature births with 7.34 and 11.19%, respectively [5]. Most of the body systems of premature babies are usually not fully developed. As a result, they require support in the majority of aspects of life, including their feeding. If the support rendered is insufficient, they are more likely to have complications such as feeding difficulties, micronutrient deficiencies, and poor growth and development. Due to this, premature babies are at great risk of death compared to babies born mature. The majority of the survivors face lifelong disabilities, such as visual, hearing, and learning problems. The challenge of premature birth and death is worth to be addressed if countries are

to achieve Sustainable Development Goals (SDGs), especially goal 3, subsection 3.2 that aims at ending all the preventable deaths of newborn babies and children aged under 5 years by 2030. Improved care and feeding of preterm babies can avert these deaths. This book chapter addresses the challenges associated with feeding preterm babies and is hoped to make a significant contribution toward ending deaths due to nutrition-associated comorbidities among this group of newborns.

2. Care and feeding of premature babies in hospital and at home

The body structures and systems of premature babies are usually not fully developed. As a result, premature babies usually have poor muscle tone, incomplete rooting, and weak gag reflexes. Premature babies also have incompetent lower esophageal sphincter and impaired rectal sphincter reflex. In addition, premature babies have high metabolic needs and are unable to store nutrients. Due to this, they are more likely to develop difficulties such as failure to suckle enough milk from the breast, poor gastric emptying, slowed intestinal motility, and impaired bowel emptying. All these affect feeding abilities and contribute to the development of nutritional deficiencies. The good news is that many of these babies can survive and grow especially if they are cared for and fed adequately.

The survival rates of premature infants can greatly improve if the emphasis is put on optimizing nutritional demands and appropriate feeding. The use of breast milk for premature babies as the feeding choice is highly recommended. In addition to nutritional values, breast milk provides premature babies with immunological defense, hormones, and enzymes that are essential for growth and development. Feeding should be initiated within 30 minutes to 1 hour of birth. Exclusive breastfeeding for 6 months is recommended. The mode of feeding initially will depend on whether the baby is stable or not. Stable babies may be able to breastfeed, while unstable babies may need parenteral nutrition in the first 24 hours. Premature babies weighing 1.5–2.0 kg or less are admitted to the Neonatal Intensive Care Unit (NICU) as well as those who are unstable. Premature babies below 1.5 kg are unstable so should not be fed by mouth for at least the first 24 hours. Initially, the health worker should establish an intravenous line and give intravenous fluids such as dextrose 10%, infant maintenance solution, or neonatal cocktail. Intravenous nutrition should provide glucose, amino acids, minerals, and vitamins plus fat in some preparations.

On day one, babies less than 1500 g should be given 80 mls per kg per day and for infants greater than 1500 g should be given 60 mls per kg per day. This should be divided and given every 2–3 hours. Once the baby stabilizes, oral feeds can be started through a Nasal Gastric Tube (NGT). From day two of life, it is important to introduce oral feeds mostly Expressed Breast Milk (EBM) with feed volumes estimated based on the body weight of the baby while continuing with intravenous fluids that have other electrolytes, especially potassium and sodium. If the baby has a birth weight of 1500 g or less and is stable, feeding is started with EBM of 5 mls and is increased carefully by 5 mls each day as shown in **Table 1**. Do not exceed the daily maximum volume of feeds as shown in **Table 2**. If the baby is between 1500 and 2000 g and is stable, then feeding can be started with 7.5 mls of EBM and also increased accordingly. If the premature baby has a weight of more than 2000 g, 10 mls of EBM is given and is also increased steadily as explained earlier.

The first choice of milk for feeding preterm babies is expressed breast milk from the mother of the baby. The second choice is donor breast milk. The donor breast milk

Day	IV	NGT
1	4mls per hour	0
2	3mls per hour	5mls 3 hourly
3	2mls per hour	10 mls 3 hourly
4	1 ml per hour	15mls 3 hourly
5	0 ml	18mls 3 hourly
6		21mls 3 hourly
7+		24mls 3 hourly

Table 1.
Intravenous and nasal gastric feeds.

Age	Total daily fluid/milk volume
Day 1	60 mls/kg/day
Day 2	80 mls/kg/day
Day 3	100 mls/kg/day
Day 4	120 mls/kg/day
Day 5	140 mls/kg/day
Day 6	160 mls/kg/day
Day 7	180 mls/kg/day

Table 2.
Total feeds given per kgs per day.

should be pasteurized. Donor pasteurized milk should be screened for human immunodeficiency virus, hepatitis B, hepatitis C, and venereal diseases. In cases where EBM from the mother or donor breast milk is not available, the premature babies may be fed on formula milk such as modified cow milk containing energy 80 kcal, protein 2.0 g, fat 4.5 g, calcium 77–110 mg, and phosphate 33–63 mg. However, premature babies fed on formula milk have been found to carry a high risk of developing Necrotizing Enterocolitis (NEC) compared to those fed on breast milk. There has also been an increase in NEC with fast or early EBM or formula milk compared to slow or delayed introduction of these feeds. While the baby is on these feeds, it is important to check random blood sugar. Usually, a random blood sugar of 2.8–8 mmols per dl or 49–140 mg per kg is considered to be within the normal range. The health worker should also monitor the quantity of fluids being given as well as the amount of urine passed within 24 hours. At least six wets per day are normal. This translates into about 0.5–1.0 ml per kg per hour. Also, observe signs of fluid overload such as swelling of face and difficulty in breathing.

After a lengthy stay in the hospital, premature babies are usually discharged to home and care is continued from there but still under the remote support of the health care worker. The premature baby will be discharged if he or she no longer needs intravenous fluids and can tolerate at least 8 oral feeds per day. The caretaker should be counseled on exclusive breastfeeding for the first 6 months, complementary feeding at 6 months of uncorrected chronological age and to practice appropriate weaning practices when the baby is able to eat adequately. The mother or caretaker is

encouraged to bring back the baby as soon as he or she develops danger signs such as feeding poorly or getting complications such as diarrhea. The baby should be discharged on multivitamin supplements and iron syrup for about 6 months. The baby should be brought back to the clinic on day 6 for the first postnatal visit. At this visit, the baby should be weighed. The baby's weight should be monitored weekly until 2.5 kg weight is attained.

3. Supplementary feeding in premature babies

Premature babies at birth have low nutrient stores since most nutrients are transferred from the mother to the baby in the last trimester of pregnancy. For instance, babies accumulate about 60% of total iron stores during the last trimester of pregnancy. In addition, during fetal growth and development in utero, the transfer of some mineral ions, such as calcium and phosphorus, from the pregnant woman to her fetus takes place in the third trimester, mainly between 32 and 36 weeks of pregnancy. This means that premature babies miss out on this and therefore are at higher risk of suffering from iron deficiency anemia and osteopenia. For these babies to catch up with normal growth and prevent these complications, additional nutrients are required. Due to this, the fortification of the baby's feeds is necessary. Feeds for premature babies should be fortified with iron, calcium, phosphorus, and vitamin D. A baby who is on full enteral feeds, should be given Vitamin D 400–1000 units per day until 6 months, calcium 120–140 mg per kg per day for the first month of life, phosphorus 60–90 mg per kg per day. At 2 weeks of age, the baby should be given iron 2–4 mg per kg per day up to 6 months of age and folate 2.5 mg weekly up to 6 months.

4. Complementary feeding and weaning practices in premature babies

When breast milk alone is no longer sufficient to satisfy the nutritional requirements of the baby, the addition of other foods and liquids to the baby's diet is necessary. The exact timing is still a debate on whether other feeds should be introduced at 6 months of age corrected or 6 months of age uncorrected. No clear recommendations for premature babies. However, premature babies are a vulnerable group who have increased nutritional requirements, are at risk of developing gastro-esophageal reflux, respiratory problems, and have delayed gross motor development. Delayed introduction of complementary feeding may result in insufficient nutritional needs [6]. It is therefore helpful for premature babies to start receiving complementary foods at 6 months of uncorrected chronological age. The weaning process should be initiated when the infant has reached at least 5 kg of body weight, is able to eat from a spoon and the weaning diet is able to provide adequate nutrition. Weaning should be started between 5 and 8 months of uncorrected age to ensure that sensitive periods for the acceptance of solid foods are not missed and to allow the development of the appropriate feeding skills.

5. Feeding development and feeding difficulties in premature babies

Feeding difficulties are common complications experienced by premature babies hospitalized in NICU. Premature babies display significant difficulty feeding by

mouth in the weeks following birth. Initially, they lack sucking skills. The overall prevalence of feeding difficulty among premature babies is as high as 42% and ranges from 6 to 84%. However, the degree of difficulty feeding entirely depends on the gestation age at birth. The problem of difficulty feeding continues to manifest among premature babies even several months after birth but reduces as the baby grows. Specific symptoms of difficulty feeding change with time as the baby grows and transits from a liquid-based diet to complementary foods. The symptoms of difficulty feeding may include behaviors such as (i) refusing to eat appropriate volumes of food or developmentally appropriate varieties of foods, (ii) symptoms of dysphagia or aspiration such as coughing, choking, gagging, or respiratory compromise while eating, (iii) difficulty feeding behaviors such as increased stress, crying, irritability, and (iv) delayed eating skills such as difficulty chewing. The contributing factors to difficulty feeding behaviors in premature babies include poor sucking skills and poor suck-swallow-breath coordination, among others [7].

The development of suckling takes two forms, that is to say, nonnutritive and nutritive sucking. Nonnutritive suckling is the type of sucking seen when an infant is not feeding. To elicit nonnutritive sucking, a finger is generally placed in the infant's mouth. In premature babies, this type of sucking is generally seen as a precursor to nutritive sucking. Some degree of nonnutritive sucking can often be elicited weeks before nutritive sucking emerges [8]. However, nonnutritive sucking generally becomes more rhythmic and stronger as the baby grows [9]. Nonnutritive sucking development among premature babies is an important milestone in the maturation process and reflects the subsequent improvement in suckling. Nutritive sucking occurs when a baby is feeding and results in the baby drawing milk into the mouth from the breast or bottle. Greater displacement of the tongue is required during nutritive sucking as compared to nonnutritive sucking [10]. Nutritive sucking is also characterized by slower, more rhythmical sucking movements, with regular breaks required for swallowing and breathing [10]. Like nonnutritive sucking, nutritive sucking skills generally improve with age and practice [11]. Once they approach mature age, it is often assumed that the nutritive feeding skills of premature babies can match those of mature babies. However, the sucking patterns of premature babies often remain significantly less coordinated and less efficient than those of mature babies at term age and beyond [12].

Swallowing and breathing utilize a common space within the pharynx, and hence, difficulties are often observed when sucking, swallowing, and breathing are not well coordinated [13]. Components of sucking, swallowing, breathing, and their coordinated activity mature at different times and rates [14]. Premature babies often swallow preferentially at different phases of respiration than those of their mature counterparts [15] and that restricts milk flow. Oral support during feeds may reduce pauses in sucking, increase rate and volume of intake during feeds. Externally paced feeding improves physiological stability during feeding [16]. For premature babies who are bottle-fed, the use of slow-flowing nipples over faster-flowing nipples improves physiological stability during feeds [17]. Babies born very premature continue to display frequent oxygen desaturation events during feeding at a mature age and spend on average 20% of their feeding time with arterial oxygen saturation levels less than 90 [18]. This may be a result of apnea events in premature babies during swallowing [19]. Apnea times have been found to reduce as babies mature [20]. Due to these issues, premature babies greatly rely on caregivers to feed them, provide adequate support and assistance during feeding, and recognize any distress cues as may occur during feeding [21].

Optimizing feeding during prematurity requires interventions aimed at directly assisting oral feeding to reduce complications that may come along. These interventions can be classified as:

a. Feeding the baby based on behavioral cues such as demand feeding, semi-demand feeding, and structured cue-based feeding. Feeding the baby *"on-demand"* simply means not worrying about the clock. *Semi-demand feeding uses infant cues and timing to determine when to offer a feed.* For example, if the baby fusses, cries, or wants to suck. The *cue-based* clinical *pathway* for oral *feeding* initiation and advancement of premature babies results in the earlier achievement of full oral *feeding*. Assessing readiness for feeding can be subjective and without *structure. Cue-based feeding* is more objective and individually tailored.

b. Strategies aimed at preparing the infant before a feed, such as oral stimulation prior to feeds, suck training, and oral tactile stimulation before feeds. *Suck training* exercises are helpful for gaining proper tongue function. Suck training increases the percentage of oral intake between 34 and 38 weeks of gestation. During suck training, the following steps should be observed; (1) the trainer should first wash hands to prevent transmitting infections to the baby. (2) the fingernails of the trainer should be short and smooth to prevent possible oral injuries, (3) the trainer should stroke the middle of the baby's lower lip with the index finger to encourage the baby to widely open his or her mouth, (4) when the baby opens the mouth, the trainer should place the finger, nail side down, into the front of the baby's mouth, (5) the baby will then suck the finger into his or her mouth, (6) if the tongue of the baby does not twist around the finger, the trainer can stroke the roof of the baby's mouth (palate), then softly press down on the back of the baby's tongue while stroking the tongue forward. This will help to pull the finger out of the baby's mouth somehow, (7) allow the baby to suck it back in, (8) then repeat this practice at least three times or until you feel the tongue come forward over the gum. Oral tactile stimulation before feeds is another strategy that can be used to prepare the premature baby to feed. It appears to improve the frequency of sucking and rate of intake during feeds and has been reported to improve the rate of breastfeeding. Oral tactile stimulation has also been reported to shorten the transition time to exclusive oral feeding.

c. Strategies aimed at supporting the infant during feeds, such as oral support during feeding and externally paced feeding. During oral support, *the jaw and cheek are supported* by placing the middle finger under the chin and the thumb and index fingers on the cheeks. It makes swallowing easier for the baby. External pacing means tipping the bottle down to slow milk flow or removing the bottle from the baby's mouth to impose a break in sucking. This *slows down the flow of milk into the nipple and the mouth,* allowing the baby to eat more slowly, and take breaks.

d. Interventions aimed at assisting respiratory support for oral feeding. Preterm babies often require noninvasive respiratory support, such as nasal continuous positive airway pressure and or high-flow nasal cannulas, to achieve full oral feeding. However, some forms of respiratory support strategies are feared by healthcare teams, as they may disrupt breath coordination if not carefully used.

6. Growth and development monitoring in premature babies

Normal growth is the progression of changes in height, weight, and head circumference that are compatible with established standards for a given population. Normal growth is a reflection of overall health and nutritional status. Premature babies are at risk for poor growth while in the Neonatal Intensive Care Unit (NICU) and after discharge. They must be closely monitored and may require interventions to promote better growth. Poor growth among preterm babies is usually an early indicator of health problems, such as nutritional and medical conditions. Parameters such as height, weight, and head circumference of a premature baby will vary depending on the gestational week of their birth and their overall health at birth as indicated in **Tables 3** and **4**. For example, a preterm baby with a gestational age of 24 weeks may attain 5 g per day while the one born at 33 weeks or later can put on as much as 30 g per day. The required weight gain in preterm babies who are born with a birth weight of more than 2 kg is 20–30 g per day. Similarly, the **height** of premature babies increases by about 1.1 centimeters every week until the completion of the ideal gestational age, which is about 40 weeks. A healthy premature baby is likely to first show improvement in the head circumference, followed by weight and height.

In premature babies, growth is monitored using different growth charts based on gestation age. Up to 36 weeks gestation, the Olsen and Bertino charts are the best growth charts to assess appropriateness for gestational age. For instance, small for gestational age or large for gestational age status. They perform relatively poorly in growth monitoring for premature babies beyond 36 weeks of age. Between 36 to 50 weeks of corrected age (10 weeks post-term), the Fenton chart is the best growth chart to assess longitudinal growth in premature babies over this period. After 4 to 8 weeks post-term, the World Health Organization growth charts for normal children can be used.

Developmental *monitoring* observes how the child grows and changes over time and whether the child meets the typical developmental milestones in playing, learning, speaking, behaving, and moving. Most premature babies go on to develop like babies born at term. But the earlier premature babies are born, the more likely it is that they will have development problems.

Gestational age in weeks	Weight in kilograms	Height in centimeters	Head circumference in centimeters
24	0.6	30	21.1
26	0.8	33	23
28	1	35.6	25
30	1.3	38.5	27
32	1.7	41.1	29
34	2.1	44	30.5
36	2.6	46.5	32.1
38	3.1	48.5	33.5
40	3.4	50.5	34.9

Table 3.
Weight, height, and head circumference of premature babies (girls).

Gestational age in weeks	Weight in kilograms	Height in centimeters	Head circumference in centimeters
24	0.65	31	22
26	0.83	34	23.5
28	1.1	36.5	25.8
30	1.4	39	27.5
32	1.8	42	29.5
34	2.25	44.9	31
36	2.7	47	32.8
38	3.2	49.5	34
40	3.6	51	35

Table 4.
Weight, height, and head circumference of premature babies (boys).

7. Summary and conclusion

The burden of premature labor and birth is still high worldwide at 10.6%and ranges from 5 to 18% of all babies born. About 80% of these occur in Africa and South Asia. In Sub-Saharan Africa, the burden ranges from 3.4 to 49.4%. In almost all countries, premature birth rates are on increase, which poses a threat to newborn health. Preterm babies are more likely to have feeding difficulties, suffer micronutrient deficiencies, and exhibit poor growth and developmental patterns. Due to this, premature babies are at great risk of death compared to babies born mature. The majority of the survivors face lifelong disabilities such as visual, hearing, and learning problems. However, there is still a window of opportunity to prevent these nutritional dilemmas, whereby improved care and feeding of preterm babies in the hospital and at home can avert these deaths as follows; a premature baby who is unstable should be given intravenous fluids in the first 24 hours. Once the baby stabilizes, oral feeds (mostly EBM) can be started on day two through a Nasal Gastric Tube (NGT) till day 7 or more while continuing the intravenous fluids until the baby is able to suckle. Babies who are able to suckle should be allowed to breastfeed immediately or within 1 hour after birth. It is recommended that the feeds of premature babies are fortified with iron, calcium, phosphorus, and vitamin D as these micronutrient stores are not adequately built and stored while the baby is still in utero. Appropriate and timely complementary feeds should be introduced to meet the nutritional needs of the baby and the weaning process should be initiated when the infant has reached at least 5 kg of body weight, is able to eat from a spoon and the diet is able to provide adequate nutrition. Sucking development and ability should always be assessed as this may pose a nutritional threat if the baby is unable to breastfeed adequately.

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Conflict of interest

The authors declare no conflict of interest.

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References

[1] World Health Organization. Preterm birth. 2018. Published February 19, 2018. Accessed January 1, 2022. Available from: https://www.who.int/news-room/fact-sheets/detail/preterm-birth

[2] De Costa A, Moller AB, Blencowe H, Johansson EW, Hussain-Alkhateeb L, Ohuma EO, et al. Study protocol for WHO and UNICEF estimates of global, regional, and national preterm birth rates for 2010 to 2019. PLoS One. 2021;**16**(10):e0258751. DOI: 10.1371/journal.pone.0258751

[3] Cao G, Liu J, Liu M. Global, regional, and national incidence and mortality of neonatal preterm birth, 1990-2019. JAMA Pediatrics. 2022;**176**(8):787-796. DOI: 10.1001/jamapediatrics.2022.1622

[4] Mabrouk A, Abubakar A, Too EK, Chongwo E, Adetifa IM. A scoping review of preterm births in sub-Saharan Africa: Burden, risk factors and outcomes. International Journal of Environmental Research and Public Health. 2022;**19**(17):10537. DOI: 10.3390/ijerph191710537

[5] Alamneh TS, Teshale AB, Worku MG, Tessema ZT, Yeshaw Y, Tesema GA, et al. Preterm birth and its associated factors among reproductive aged women in sub-Saharan Africa: Evidence from the recent demographic and health surveys of sub-Sharan African countries. BMC Pregnancy and Childbirth. 2021;**21**(1):1-11. DOI: 10.1186/s12884-021-04233-2

[6] Vissers KM, Feskens EJ, van Goudoever JB, Janse AJ. The timing of initiating complementary feeding in preterm infants and its effect on overweight: A systematic review. Annals of Nutrition and Metabolism. 2018;**72**(4):307-315. DOI: 10.1159/000488732

[7] Pados BF, Hill RR, Yamasaki JT, Litt JS, Lee CS. Prevalence of problematic feeding in young children born prematurely: A meta-analysis. BMC Pediatrics. 2021;**21**(1):1-15. DOI: 10.1186/s12887-021-02574-7

[8] Hack M, Estabrook MM, Robertson SS. Development of sucking rhythm in preterm infants. Early Human Development. 1985;**11**(2):133-140. DOI: 10.1016/0378-3782(85)90100-8

[9] Neiva FCB, Leone C, Leone C. Non-nutritive sucking scoring system for preterm newborns. Acta Paediatrica. 2008;**97**(10):1370-1375. DOI: 10.1111/j.1651-2227.2008.00943.x

[10] Miller JL, Kang SM. Preliminary ultrasound observation of lingual movement patterns during nutritive versus non-nutritive sucking in a premature infant. Dysphagia. 2007;**22**(2):150-160. DOI: 10.1007/s00455-006-9058-z

[11] Pickler RH, Chiaranai C, Reyna BA. Relationship of the first suck burst to feeding outcomes in preterm infants. The Journal of Perinatal & Neonatal Nursing. 2006;**20**(2):157. DOI: 10.1097/00005237-200604000-00010

[12] Iwayama K, Eishima M. Sucking behavior of normal full-term and low-risk preterm infants. No to Hattatsu=. Brain and Development. 1995;**27**(5):363-369 Available from: https://europepmc.org/article/med/7576781

[13] Daniels H, Devlieger H, Casaer P, Callens M, Eggermont E. Nutritive and non-nutritive sucking in preterm infants. Journal of Developmental Physiology. 1986;8(2):117-121. Available from: https://europepmc.org/article/med/3675720

[14] Amaizu N, Shulman R, Schanler R, Lau C. Maturation of oral feeding skills in preterm infants. Acta Paediatrica. 2008;**97**(1):61-67. DOI: 10.1111/j.1651-2227.2007.00548.x

[15] Mizuno K, Ueda A. The maturation and coordination of sucking, swallowing, and respiration in preterm infants. The Journal of Pediatrics. 2003;**142**(1):36-40. DOI: 10.1067/mpd.2003.mpd0312

[16] Law-Morstatt L, Judd DM, Snyder P, Baier RJ, Dhanireddy R. Pacing as a treatment technique for transitional sucking patterns. Journal of Perinatology. 2003;**23**(6):483-488. DOI: 10.1038/sj.jp.7210976

[17] Fucile S, Gisel E, Schanler RJ, Lau C. A controlled-flow vacuum-free bottle system enhances preterm infants' nutritive sucking skills. Dysphagia. 2009;**24**(2):145-151. DOI: 10.1007/s00455-008-9182-z

[18] Thoyre SM, Carlson J. Occurrence of oxygen desaturation events during preterm infant bottle feeding near discharge. Early Human Development. 2003;**72**(1):25-36. DOI: 10.1016/S0378-3782(03)00008-2

[19] Mathew OP. Respiratory control during nipple feeding preterm infants. Pediatric Pulmonology. 1988;**5**(4):220-224. DOI: 10.1002/ppul.1950050408

[20] Reynolds EW, Grider D, Caldwell R, Capilouto G, Vijaygopal P, Patwardhan A, et al. Swallow–breath interaction and phase of respiration with swallow during nonnutritive suck among low-risk preterm infants. American Journal of Perinatology. 2010;**27**(10):831-840. DOI: 10.3389/fped.2017.00214

[21] Thoyre SM, Brown RL. Factors contributing to preterm infant engagement during bottle-feeding. Nursing Research. 2004;**53**(5):304. DOI: 10.1097/00006199-200409000-00005