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Determinants of Weight Gain Process in Premature Infants Admitted to Neonatal Intensive Care Unit

Fateme Jaafarian[1,2], Mohammad Ali Mohsenpour[1,2], Seyedeh Forough Sajjadi[3], Mohammad Hassan Eftekhari[2*]

1. Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran
2. Department of Clinical Nutrition, School of Nutrition and Food Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
3. Department of Community Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran

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**Corresponding author:*
Mohammad Hassan Eftekhari, PhD;
Department of Clinical Nutrition, School of Nutrition and Food Sciences, Shiraz University of Medical Sciences, Shiraz, Iran.
Tel: +98 71 37251001
Email: h_eftekhari@yahoo.com
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ABSTRACT

Background: A premature birth is a life threatening situation that causes an increase in infant death. The aim of the present study was to investigate the contributing factors to the weight gain process in premature infants in the Neonatal Intensive Care Unit (NICU).

Methods: The present birth cohort study was performed on 47 premature infants born in Hafez Hospital in Shiraz, Iran from July 2019 to February 2020. Infants born before the 37th gestational week, who were hospitalized for at least 7 days were included in the study. Demographic and anthropometric data, feeding conditions and supplements, durations of hospitalization, and nothing by mouth (NPO) state, before breastfeeding, and before initiation of oral feeding were recorded.

Results: Twenty eight (59.57%) boys and nineteen (40.42%) girls (n=47) with median of 13 days hospitalization were enrolled. Intakes of amino acid solution ($p<0.001$), lipid emulsion ($p=0.04$), phosphorus ($p=0.01$), and folic acid ($p=0.02$) were correlated with weight gain process. Results showed a significant linear correlation between hospitalization duration ($p<0.001$), NPO duration ($p=0.02$), and duration before beginning breastfeeding ($p=0.02$) and weight gain pattern. However, there was no significant relationship between the process of weight gain and the duration before initiation of oral feeding ($p=0.61$).

Conclusion: Earlier breastfeeding initiation and longer hospitalization, and amino acid supplementation can improve weight gain in the premature infants. Further studies are recommended.

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Introduction

Every year, about 15 million premature infants are born worldwide comprising more than 10% of all infants born (1). Premature birth refers to the birth of a baby occurring before 37th weeks of gestation (2), and its prevalence varies in different societies (3). According to another estimation by the World Health Organization, it is estimated that the incidence of low birth weight (LBW) is 15.5%, and 95.5% of infants with low birth weight are born in developing countries (4). The statistics show that 8-10% of newborns in the United States and 5-7%

of newborns in Europe are premature. With an incidence of 12%, Iran is among the countries with a high prevalence of preterm labor (3).

Proper feeding and providing all essential nutrients to premature infants enhances growth, increases neurodevelopment, and lowers morbidities (5, 6). Feeding premature infants due to underdevelopment of the gastrointestinal tract and intolerance of oral intake, initially begins intravenously, which gradually decreases with the improvement of gastrointestinal function and the beginning of intestinal feeding, and eventually, intravenous feeding is stopped (7). A well-tolerated nutritional support and feeding method which improves growth and the physiological condition is breastfeeding (8). However, it is difficult for a premature baby to transfer feeding from intravenous and intestinal feeding to direct breastfeeding due to immaturity or lack of the necessary conditions including sucking-swallowing-breathing pattern, proper muscle tension, and respiratory maturity (9-11).

These issues in the changing nutrition route which causes endangering the safety of the baby, lead to more energy consumption by the baby, and may lead to developmental delays and growth failure (12). Since nutritional measures at Neonatal Intensive Care Unit (NICU) are important determinants of growth rate (13), high-quality nutritional support in the first weeks after birth, not only reduces infant mortality; but also amends weight gain, growth in length, and head circumference (14). In addition to nutritional intervention, pharmacological interventions, hospitalization, and quality of services in NICU can affect premature infants' growth process (15).

Hospitalization duration affects premature infants' growth (16). In most cases, premature infants experience a period of hospitalization in the NICU. Several factors are considered to determine the length of NICU stay including breastfeeding acceptance, physiological stability, regulation of body temperature, improvement of respiratory issues, and weight gain (17, 18). Also, complete sucking and swallowing in premature infants are signs of proper development that are important factors in deciding to discharge these infants from the hospital (19). Among the factors that shorten the infants' hospitalization period is the rapid initiation of breastfeeding, which is associated with the weight gain process. Thus, there is a mutual relation between weight gain and hospitalization duration. The duration before discharge is specifically one of the weight gain factors (20). Thus, due to the increasing prevalence of premature births, the effect of nutrition on the growth and neural development of the infant, the long-term consequences of hospitalization, and the imposition of high medical costs on the family; this birth cohort aimed to investigate the contributing factors with the weight gain process of preterm infants from birth to discharge from the NICU ward.

Materials and Methods

The present birth cohort study aimed to assess the contributing factors for the weight gain process among preterm infants hospitalized in NICU, from birth to discharge. The study was carried out from July 2019 to February 2020 in the NICU ward of Hafez Hospital, affiliated with Shiraz University of Medical Sciences (SUMS), Shiraz, Iran, which was discontinued after 6 months of running due to the covid-19 pandemic announcement in Iran. The study protocol was approved by the institutional review board (IRB) and the ethics committee of Shiraz University of Medical Sciences under the approval code of IR.SUMS.REC.1398.587.

In order to conduct this study, the sample size was determined, but as the study was terminated due to the covid-19 pandemic, all the eligible preterm infants who were hospitalized in the NICU ward during this period were included in the study. In order to diagnose of being preterm, infants born <37 weeks based on the gestational age were known as preterm (21). Preterm infants were eligible for this study if were expected to be hospitalized at least for 7 days, unable to receive oral feeding, and not suffering from any congenital or chromosomal abnormalities affecting gastrointestinal function and growth. Infants who were unlikely to survive for the first week, deceased during the first seven days, and in case of the unwillingness of parents or legal guardians, were excluded from the study.

A checklist was provided to record infants' demographic and clinical data. The clinical data were the feeding method and supplements, days to begin breastfeeding or oral feeding (the number of days before starting breastfeeding or oral feeding), and anthropometrics. Anthropometric measurements were done by a registered nurse. The length and head circumference were measured using an inelastic tape measure with an accuracy of 1 cm. In order to measure the length, the infant's head and legs were held still, while facing up and the knees were straight. After ensuring the top of the head and bottom of the feet touched the boards, the length was measured. The largest circumference of the head was measured for head circumference. A B-well digital scale (model: WK-160; Switzerland) with an accuracy of 1 gram was used to measure the infant's weight. Due to the infants' condition, infants were fed via intravenous, enteral, or a combination of these methods. The

feeding type and supplementation including hypo-allergic protein, carbohydrates, lipids, vitamins, and minerals were also recorded.

Statistical analysis was performed using SPSS software (version 22; IBM, USA). The normal distribution of data was assessed using the Shapiro-Wilk test. Between-group comparisons for normal distributed and skewed data were done using an independent sample T-test and Mann-Whitney U test, respectively. The spearman test was used to assess relations between weight change and possible contributing factors. Variables that showed significant results were entered into linear regression. A *p* value less than 0.05 was considered significant.

Results

During the 6 months of running the study, overall, 47 eligible preterm infants (28 boys, and 19 girls) were hospitalized for 13 days (median) in the NICU ward of the Hafez hospital. A net weight reduction was seen for neonates during the study period (-164.45±284.04 grams per week). Table 1 summarizes the general characteristics of preterm infants. Table 2 shows the weight change according to the feeding type and supplementation. Results indicated that supplementations with amino acid solution ($p<0.001$), lipids emulsion ($p=0.04$), phosphate ($p=0.01$), and folic acid ($p=0.02$) were seen in improved weight gain process. Ferrous sulfate showed a marginally insignificant relation with weight gain ($p=0.06$).

Table 3 shows the relationship between the weight change process and dependent variables. There was a significant positive correlation between the hospitalization duration (r=0.45, $p<0.001$, Figure 1), the NPO duration (r=0.34, $p=0.02$, Figure 2), and the days to initiate breastfeeding (r=0.33, $p=0.02$, Figure 3) and less weight loss. However, there was no significant relationship between the process of the preterm infants' weight changes and the number of days it took for the infant to start oral feeding (by the cup, glass, etc., r=0.07, $p=0.61$).

Variables that showed significant relationships with weight changes in preterm infants were birth weight, height, head circumference, NPO duration, number of days to begin oral feeding, hospitalized duration, consumption of lipid emulsion, amino acid solution, phosphorus, ferrous sulfate, and folic acid, which entered into the linear regression model with the stepwise method. Results of the linear regression indicated only two variables of amino acid solution intake and the hospitalization duration were significantly associated with weight change process in the model (Adjusted $R^2=0.322$). The average weight gain of the infants who received amino acid solution was 26.64 grams more than the babies who did not receive this supplement. Also, in relation to the hospitalization duration, with an increase of 1 day in the length of stay in the hospital, an increment of 1.06 grams occurred in preterm infants' weight.

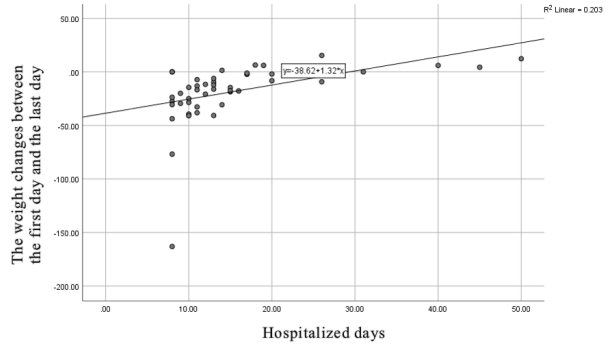

Figure 1: Relationship between preterm infants' weight change process and the hospitalization duration.

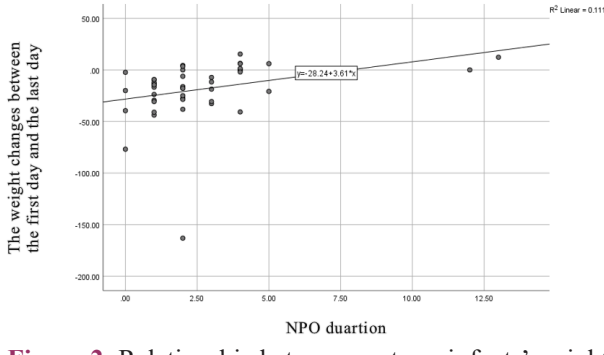

Figure 2: Relationship between preterm infants' weight change process and NPO duration.

Table 1: General characteristics of preterm infants (n=47).

Variable	Mean±SD/Median (IQR)	Min	Max
Gestational age (week)	33.44±2.36	28	39
Birth weight (g)	2105.74±619.10	820	3440
Birth length (cm)	45.27±5.38	28	55
Head circumference at birth (cm)	32.07±3.28	25	45
Weight changes (g/week)	-164.45±284.04	615	-1304.96
Hospitalized duration (day)	13 (7)	8	50
Days to begin breastfeeding (day)	7 (6)	2	33
NPO duration (day)	2 (3)	0	13
Days to begin oral feeding (day)	2 (1)	1	5

SD: Standard deviation, IQR: Inter quartile range.

Table 2: The mean weight changes of preterm infants based on the supplementation (n=47).

Variable		N (%)	Intake (mean±SD)	Weight change (g) (Median, (IQR))	*p* value*
HMF	Yes	14 (29.78)	5.58±5.47	-4.09 (26.26)	0.46
(g)	No	33 (70.21)		-16.15 (27.42)	
Amino acid solution	Yes	33 (70.21)	0.24±0.50	-8.25 (17.95)	< 0.001
(g/kg/day)	No	14 (29.78)		-30.07 (21.11)	
Lipid emulsion	Yes	14 (29.78)	1.62±0.35	0.00 (21.79)	0.04
(g/kg/day)	No	33 (70.21)		-17.66 (23.47)	
P (Glycophos)	Yes	18 (38.29)	2.41±0.88	0.00 (22.54)	0.01
(mL/kg)	No	29 (61.7)		-20.00 (21.76)	
Zinc	Yes	14 (29.78)	0.59±0.15	-3.07 (20.16)	0.17
(g/kg)	No	33 (70.21)		-17.81 (28.86)	
Ferrous sulfate	Yes	3 (6.38)	1.18±0.24	6.00 **	0.06
(mg/kg)	No	4 (93.61)		-15.40 (27.12)	
Acid folic	Yes	15 (31.91)	0.26±0.06	0.00 (20.66)	0.02
(mg/kg)	No	32 (68.08)		-18.9 (21.36)	
Calcium	Yes	26 (55.31)	1.93±0.42	-12.05 (29.59)	0.87
(mg/kg)	No	21 (44.68)		-16.81 (22.88)	
Multivitamin	Yes	45 (95.74)	2.00	-14.66 (27.39)	0.14
(drops/day)	No	2 (4.25)		0.71 **	
NaCl	Yes	46 (97.87)	1.92±0.56	-13.84 (27.75)	- †
(mL/kg)	No	1 (2.12)		0.00	
KCl	Yes	46 (97.87)	1.60±0.42	-13.84 (27.75)	- †
(mL/kg)	No	1 (2.12)		0.00 **	
B-complex+C	Yes	42 (89.36)	0.34±0.18	-15.40 (28.74)	0.60
(mL/day)	No	5 (10.63)		-9.23 (27.99)	
Vitamin K	Yes	27 (57.44)	0.11±0.07	-11.26 (20.00)	0.29
(mL/day)	No	20 (42.55)		-21.20 (35.17)	
Vitamin D	Yes	5 (10.63)	25	-2.00 (25.73)	0.60
(drop/day)	No	42 (89.36)		-14.58 (28.86)	
Vitamin A	Yes	2 (4.25)	5000	6.15 **	0.14
(mL/day)	No	45 (95.74)		-14.66 (27.39)	

HMF: Human milk fortifier; SD: Standard deviation; IQR: Inter quartile range, *Mann-Whitney U test, **IQR was not able to calculate due to the limitation of samples in one group, †Due to the large difference between the infants in the groups, the p-value could not be calculated. $P<0.05$ was considered significant.

Table 3: Correlation between weight change process and dependent variables in the study (n=47).

	Variable	r	*p* value*
Weight change process	Hospitalized duration	0.45	<0.001
	Days to begin breastfeeding	0.34	0.02
	NPO duration	0.33	0.02
	Days to begin oral feeding	0.07	0.61

*Spearman test, $p<0.05$ was considered significant.

Discussion

In this study, the factors affecting the weight gain process of premature infants were studied. Factors affecting the infant's weight included the hospitalization duration, the NPO duration, and the time it took for the infant to receive direct breastfeeding. However, the number of days it took for the baby to receive oral feeding did not affect her/his weight gain. Moreover, amino acid solution supplementation and longer hospitalization duration were associated with higher weight gain among premature infants. The results of this study showed that the infant's weight gain was directly related to the number of days he stays in the hospital.

The results of our study were contrary to the findings of the study of AlJohani *et al.* (22), who conducted their study to investigate the cause of infant mortality in the intensive care unit. The results of this study showed that there was an inverse relationship between the length of stay of the infant in the hospital and his weight gain and the less the baby weighs, the longer he stays in the hospital. The

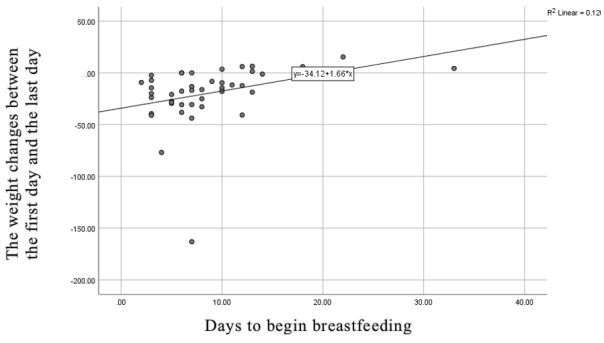

Figure 3: Relationship between preterm infants' weight change process and the number of days to begin breastfeeding.

study by Manktelow *et al.* (23), which looked at factors affecting infants' length of stay, found that the infant's weight and the week of birth had a greater effect on the infant's length of hospital stay than other factors, including illness and other maternal factors and the more the baby weights and the longer baby week of birth, the shorter the hospital stay. This discrepancy between the results of the present study and previous studies may be explained by the small sample size. It may also be due to the mother's lack of awareness of the baby's care and nutrition, which occurs better with hospitalization and with the help of nurses and weight gain.

Also, in the present study, there was a significant positive relationship between the number of days to reach breastfeeding (independent feeding) and the duration of infant NPO with the weight gain process. Also, in this study, there was no significant relationship between the time to reach oral feeding by cup and bottle and the process of infant weight gain. Maas *et al.* in their study, in addition to the main results of the study that breastfeeding enrichment cannot significantly improve infant weight, stated that early initiation of infant breastfeeding will improve infant weight (24). Halvorson *et al.* also reviewed their study to investigate the effect of infant NPO duration on hospital stay and weight gain and they concluded that the longer the baby's NPO lasts, the less the baby weighs and the longer he stays in the hospital (25). However, in the same study, it was noted that if the infant receives the energy he needs during NPO through enteral feeding, his length of hospital stay will be shorter (25).

Marofi *et al.* in a study comparing cup and palady feeding on weight gain and sooner oral and breastfeeding, concluded that the palady group received oral feeding sooner and also, gained more weight than the group receiving milk with a cup (14). Dalal *et al.* in their study pointed out that the reason for this was improvement in the nutritional performance of premature infants during the first two days of birth and their arrival at breastfeeding (26). The differences between this study and studies that found that earlier breastfeeding resulted in improved weight gain in infants may be due to differences in infant age (week of birth), neonatal diseases that delay breastfeeding, and the small sample size to be studied.

Also, because premature babies do not have strong jaw muscles to suckle on the breasts, they receive less energy from breast milk when they receive breast milk directly from their breasts. For this reason, when the baby is NPO or when she is fed enterally or parenterally, her/his energy needs are completely met. And the longer it takes for the baby to breastfeed, the better the energy needs are met and the better weight gain occurs. It was also considered due to the reduction of infant energy intake in breastfeeding compared to NPO feeding and better intake of nutrients through enteral and parenteral.

Our results revealed that supplementation with folic acid, amino acid solutions, and lipids emulsions can improve the weight gain process. Akker *et al.* investigated the effect of amino acid supplementation (27). The results of Akker's study indicated premature infants will benefit from supplementing 2.4 g/kg/day amino acids following birth (27). Moreover, a study done by Valentine *et al.* on amino acid supplementation by comparing two cohort studies in early amino acid supplementation and late supplementation, concluded that earlier supplementation with amino acids is associated with a better weight gain process (28).

These results supported our findings. Thus amino acid supplementation could improve the weight gain process of premature infants in NICU. On the other hand, we saw lipid emulsion supplement can help premature infants to have a better weight gain pattern. Najm *et al.* compared the two different types of lipid emulsions in growth and morbidities in premature infants. The results of their study did not show any beneficial effect between two types of emulations (29). A Cochrane meta-analysis did not demonstrate any improvements in premature growth via lipid supplementation (30). Our study showed no weight reduction in infants with lipid supplementation, but this discrepancy could be due to the low sample size and short study duration.

As the population of this study was premature infants, the study became more complicated and with a high risk. Moreover, prematurity caused the lack of cooperation of the baby, and the presence of confounding factors that affected the infant's weight such as the mother's age at birth, birth age, various neonatal diseases, and physical problems

such as cleft lip and palate may interfere the overall results. The covid-19 pandemic limited our sampling, which was due to the dangers of visiting the intensive care unit (ICU) and being placed next to infants, consequently because of transmitting the infection, the study was terminated and the goals of this study were not fully achieved and fewer infants participated in this study. In future studies, researchers can conduct this research with a higher sample size, careful examination of infant weight, and classification of infants based on the present conditions, including diseases.

Conclusion

In this study, it was shown that earlier feeding of infants with breast milk and earlier oral delivery for infants can lead to an improved weight gain. Also, the longer the infant stays in the hospital, the better his development and weight gain will happen. Moreover, weight gain process of premature infants can benefit from supplementation of amino acids solutions.

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Conflict of Interest

None declared.

References

1 Blencowe H, Cousens S, Oestergaard MZ, et al. National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. *Lancet*. 2012;379:2162-72. DOI: 10.1016/S0140-6736(12)60820-4. PMID: 22682464.

2 Varma R, James D. Antenatal care of women with previous preterm delivery. *Curr Obstet Gynaecol*. 2004;14:207-15. DOI: 10.1016/j.curobgyn.2004.02.006.

3 Martin JAJhwcgndnnnp. Births: final data for 2010. *Natl Vital Stat Rep*. 2012;61:1-72. PMID: 24974589.

4 Organization WH. UNICEF-WHO low birthweight estimates: levels and trends 2000-2015. World Health Organization; 2019.

5 Bouyssi-Kobar M, du Plessis AJ, McCarter R, et al. Third trimester brain growth in preterm infants compared with in utero healthy fetuses. *Pediatrics*. 2016;138:e20161640. DOI: 10.1542/peds.2016-1640. PMID: 27940782.

6 Ehrenkranz RA, Dusick AM, Vohr BR, et al. Growth in the neonatal intensive care unit influences neurodevelopmental and growth outcomes of extremely low birth weight infants. *Pediatrics*. 2006;117:1253-61. DOI: 10.1542/peds.2005-1368. PMID: 16585322.

7 Alur P, Kalikkot Thekkeveedu R, Meeks M, et al. Calorie intake is associated with weight gain during transition phase of nutrition in female extremely low birth weight infants. *Biol Sex Differ*. 2020;15:11:16. DOI: 10.1186/s13293-020-00295-7. PMID: 32293535.

8 Arslanoglu S, Boquien C-Y, King C, et al. Fortification of human milk for preterm infants: Update and recommendations of the European milk bank association (emba) working group on human milk fortification. *Front Pediatr*. 2019;22;7:76. DOI: 10.3389/fped.2019.00076. PMID: 30968003.

9 Callen J, Pinelli J. A review of the literature examining the benefits and challenges, incidence and duration, and barriers to breastfeeding in preterm infants. *Adv Neonatal Care*. 2005;5:72-88. DOI: 10.1016/j.adnc.2004.12.003. PMID: 15806448.

10 Mansori K, Babaei H, Rahmani P. The Effect of Non-nutritive Sucking on Mother's Finger on Feeding Tolerance and Attainment of Independent Oral Feeding in Preterm Infants: A Randomized Trial. *Int J Pediatr*. 2018;6:8715-25. DOI: 10.22038/ijp.2018.33045.2919.

11 Tenhaaf J. Critical review: The effects of oral stimulation on feeding behaviours in preterm infants. *School of Communication Sciences and Disorders, the University of Western Ontario*. 2008:230-6.

12 Medoff-Cooper B, Rankin K, Li Z, et al. Multi-sensory intervention for preterm infants improves sucking organization. *Adv Neonatal Care*. 2015;15:142. DOI: 10.1097/ANC.0000000000000166. PMID: 25822519.

13 Cooke R, Ainsworth S, Fenton A. Postnatal growth retardation: a universal problem in preterm infants. *Arch Dis Child Fetal Neonatal Ed*. 2004;89:F428-F30. DOI: 10.1136/adc.2001.004044. PMID: 15321963.

14 Marofi M, Abedini F, Mohammadizadeh M, et al. Effect of palady and cup feeding on premature neonates' weight gain and reaching full oral feeding time interval. *Iran J Nurs Midwifery Res*. 2016;21:202. DOI: 10.4103/1735-9066.178249.

PMID: 27095996.
15 Strydom K, Van Niekerk E, Dhansay M. Factors affecting body composition in preterm infants: Assessment techniques and nutritional interventions. *Pediatr Neonatol*. 2019;60:121-8. DOI: 10.1016/j.pedneo.2017.10.007. PMID: 29239827.
16 Lee EJ, Lee SY. The effects of early-stage neurodevelopmental treatment on the growth of premature infants in neonatal intensive care unit. *J Exerc Rehabil*. 2018;14:523. DOI: 10.12965/jer.1836214.107. PMID: 30018943.
17 Lessen BS. Effect of the premature infant oral motor intervention on feeding progression and length of stay in preterm infants. *Adv Neonatal Care*. 2011;11:129-39. DOI: 10.1097/ANC.0b013e3182115a2a. PMID: 21730902.
18 Altman M, Vanpée M, Bendito A, et al. Shorter hospital stay for moderately preterm infants. *Acta Pediatr*. 2006;95:1228-33. DOI: 10.1080/08035250600589058. PMID: 16982495.
19 Neiva FCJI. Non-nutritive sucking evaluation in preterm newborns and the start of oral feeding: a multicenter study. *Clinics*. 2014;69:393-7. DOI: 10.6061/clinics/2014(06)05. PMID: 24964303.
20 Askanazi J, Hensle TW, Starker PM, et al. Effect of immediate postoperative nutritional support on length of hospitalization. *Ann Surg*. 1986;203:236. DOI: 10.1097/00000658-198603000-00002. PMID: 3082301.
21 Pennell CE, Jacobsson B, Williams SM, et al. Genetic epidemiologic studies of preterm birth: guidelines for research. *Am J Obstet Gynecol*. 2007;196:107-18. DOI: 10.1016/j.ajog.2006.03.109. PMID: 17306646.
22 AlJohani E, Qaraqei M, Al-Matary A. Estimating the neonatal length of stay for preterm babies in a saudi tertiary hospital. *J Clin Neonatol*. 2020;9:13. DOI: 10.4103/jcn.JCN_115_19
23 Manktelow B, Draper E, Field C, et al. Estimates of length of neonatal stay for very premature babies in the UK. *Arch Disease Child Fetal Neonatal Ed*. 2010;95:F288-F92. DOI: 10.1136/adc.2009.168633. PMID: 20530099.
24 Maas C, Wiechers C, Bernhard W, et al. Early feeding of fortified breast milk and in-hospital-growth in very premature infants: a retrospective cohort analysis. *BMC Pediatr*. 2013;13:178. DOI: 10.1186/1471-2431-13-178. PMID: 24180239.
25 Halvorson EE, Chandler N, Neiberg R, et al. Association of NPO status and type of nutritional support on weight and length of stay in infants hospitalized with bronchiolitis. *Hosp Pediatr*. 2013;3:366-70. DOI: 10.1542/hpeds.2013-0011. PMID: 24435195.
26 Dalal SS, Mishra S, Agarwal R, et al. Feeding behaviour and performance of preterm neonates on Paladai feeding. *Acta Paediatr*. 2013;102:e147-e52. DOI: 10.1111/apa.12148. PMID: 23294423.
27 Van den Akker CH, Te Braake FW, Weisglas-Kuperus N, et al. Observational outcome results following a randomized controlled trial of early amino acid administration in preterm infants. *J Pediatr Gastroenterol Nutr*. 2014;59:714-9. DOI: 10.1097/MPG.0000000000000549. PMID: 25187104.
28 Valentine C, Fernandez S, Rogers L, et al. Early amino-acid administration improves preterm infant weight. *J Perinatol*. 2009;29:428-32. DOI: 10.1038/jp.2009.51. PMID: 19444236.
29 Najm S, Löfqvist C, Hellgren G, et al. Effects of a lipid emulsion containing fish oil on polyunsaturated fatty acid profiles, growth and morbidities in extremely premature infants: a randomized controlled trial. *Clin Nutr ESPEN*. 2017;20:17-23. DOI: 10.1016/j.clnesp.2017.04.004. PMID: 29072164.
30 Amissah EA, Brown J, Harding JE. Fat supplementation of human milk for promoting growth in preterm infants. *Cochrane Database Syst Rev*. 2018;19:6. DOI: 10.1002/14651858.CD000341. PMID: 29924388.