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*Original Research*

# Effects of a fixed-time feeding method on physiological parameters in preterm infants



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**Abstract**
Aim: This study investigated the effects of fixed-time (study group) and gravity (control group) feeding methods on respiratory rate, oxygen saturation, heart rate, and gastric residual volume in preterm infants.
Material and Methods: This study was conducted in the neonatal intensive care unit. Preterm infants were fed with fixed-time and gravity feeding methods. The physiological parameters of the preterm infants were recorded.
Results: Compared with the control group, preterm infants in the study group exhibited lower respiratory rate ($p < 0.05$), lower heart rate ($p < 0.05$) and higher oxygen saturation ($p < 0.05$) during feeding. There was no statistically significant difference between the groups in terms of gastric residual volume ($p > 0.05$).
Discussion: Lower respiratory and heart rates and higher oxygen saturation rate were observed in infants fed by a fixed-time feeding method. The fixed-time feeding method may be suggested for use by healthcare professionals during the treatment of preterm infants.

**Keywords**
Feeding Methods, Intermittent Feeding, Neonatal Intensive Care, Prematurity

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## Introduction

A systematic review of studies conducted in 107 countries showed a global preterm birth rate of 10.6% of live births; the incidence of preterm birth (< 37 weeks of gestation) is increasing [1]. Premature and low birth weight infants are more likely to develop nutritional deficiencies because of organ or system immaturity, metabolic disorders, limited nutritional reserves, high growth rate, and intensive catabolism [2].

Intermittent bolus feeding is defined as feeding for 10–20 min at 2–3-h intervals, usually by gravity or an electric pump [3]. Of these, the gravity method is often used in intermittent bolus feeding [4-6], with a feeding duration of 10–30 min [5-7]. However, it is unclear whether this is the most effective method for preterm infants, or whether it ensures quality care [8]. Intermittent bolus feeding is regarded as physiological because it causes cyclical fluctuations of gastrin, gastric inhibitory peptide, and insulin in the infant digestive system, thus supporting gastrointestinal system development [9]. Intermittent feeding increases protein synthesis and improves protein balance in infants, both of which play important roles in the regulation of nutritional disorders [10]. A previous meta-analysis confirmed the utility of intermittent feeding [11].

In neonatal intensive care units, the feeding duration of preterm infants who receive intermittent feeding must be evidence-based and appropriate. In the literature, a fixed time for intermittent feeding has not yet been reported. In the gravity feeding method used in our clinic, a single meal comprises 10–30 ml of food administered to the infant over a mean duration of 10 min with the aid of gravitation. The physiological parameters of the infants have been reported to change during feeding because of the rapid flow. In a study comparing kangaroo care and prone position, both groups were fed by a pump for 30 min [12]. To our knowledge, no published studies have examined differences in respiratory rate, oxygen saturation, heart rate, or gastric residual volume in preterm infants between feeding with a longer-duration fixed-time method and feeding with the gravity method. In this study, these parameters were compared in infants fed for a period > 10 min and infants fed for a fixed time.

## Material and Methods

### *Design*

This randomized controlled trial was designed to determine the effect of the fixed-time (study group) and gravity (control group) feeding methods on respiratory rate, oxygen saturation, heart rate, and gastric residual volume in preterm infants before, during and after the feeding period. Study approval was obtained from the Clinical Trials Ethics Committee of Biruni University (no: 2015-KAEK-43-18-09). Written informed consent was obtained from the infants' parents.

### *Participants*

The study was conducted in our neonatal intensive care unit between June 2018 and October 2019. Based on a power analysis (G*Power 3.1.9.2) calculated for this study and using the method established in a previous study [13], the number of samples determined for power: 0.80, β: 0.05 and α: 0.05 was identified as a total of 28 including minimum 14 for each group. To plan for possible losses, the sample size was set at 30 infants, with 15 infants per group. Figure 1 presents a CONSORT flow diagram [14] of the study.

The study population consisted of infants at a gestational age ≤ 32 weeks and a birth weight ≤ 1500 g. Infants who switched to full enteral feeding (minimum 150 ml/kg/day) were included in the study. The exclusion criteria for preterm infants were as follows: major congenital anomaly, multiple organ failure, central nervous system disease, history of birth asphyxia, ongoing need for invasive mechanical ventilation, hemodynamically significant patent ductus arteriosus, and proven sepsis during the study.

Infants who met the inclusion criteria were assigned to either the study group or the control group using urn randomization [15], with the white ball indicating the study group and the red ball indicating the control group. A nurse working in the unit made the selection with closed eyes, which ensured the random distribution of infants between the two groups.

### *Measures*

An infant information form was prepared by the researchers and included questions regarding sex, gestational age, postmenstrual age, weight, length of orogastric tube, feeding amount, food type, and respiratory support during transition to full enteral feeding. A feeding monitoring program was used to record the respiratory rate, oxygen saturation, and heart rate of infants before, during, and after feeding. Before the start of the next feeding, gastric residual volume was measured and then recorded in the form.

### *Procedure*

The first orogastric tube was inserted after birth using the NEMU method (measuring from mouth to the earlobe, then to the xiphoid appendix and middle point of the umbilicus). The correct length and correct positioning of the tube were confirmed during chest radiography, performed in the clinic for examination purposes. The tube length of each infant was recorded in the research form.

Fixed time feeding method (study group)

Infants were placed in the prone position before the initiation of monitoring with a device that recorded the data every minute for 15 min between 09:45 am and 10:00 am. Researchers administered food to the preterm infant via the orogastric tube within 20 min with the aid of a pump, beginning at 10:00 am. The variables were measured every minute for 20 min. After the feeding, monitoring was continued; data were recorded every minute for 15 min. The gastric residual volume was assessed for either 2 h (infants weighing < 1250 g were fed at a 2-h interval) or 3 h (infants weighing > 1250 g were fed at a 3-h interval) after the end of feeding until the next feeding was performed.

### *Gravity feeding method (control group)*

Infants were placed in the prone position before the initiation of monitoring with a device that recorded data every minute for 15 min between 09:45 am and 10:00 am. The infants were fed via the orogastric tube at 10:00 am with the aid of gravity. The height of the tube from the stomach was set at 15 cm and the duration of feeding was recorded. Variables were measured every minute during feeding. After the feeding, monitoring was continued; data were recorded every minute for 15 min. Gastric residual volume was assessed as described above.

### *Statistical analysis*

The Number Cruncher Statistical System (NCSS) 2007 (Kaysville, UT, USA) program was used for statistical analyses. Descriptive statistical methods (mean, standard deviation, median, frequency, ratio, and range) were used to analyze the data. The normal distribution of the quantitative data was tested using the Kolmogorov–Smirnov test, Shapiro–Wilk test, and graphical evaluations. Student's t-test was used to compare normally distributed quantitative data between the two groups; the Mann–Whitney U test to compare non-normally distributed data. The Pearson chi-squared test, Fisher-Freeman-Halton exact test, and Fisher's exact test were used to compare qualitative data. A repeated measures test (repeated measures analysis of variance) was used to evaluate normally distributed variables, and a Bonferroni test was used to perform pairwise comparisons. Statistical significance was defined as $p < 0.05$.

## Results

The study flow chart is shown in Figure 1. The descriptive characteristics and some variables did not significantly differ between groups (Table 1). The mean duration of infant feeding in the control group was 5.47 ± 2.29 min (range, 3–12 min; median = 5 min). The respiratory rate during feeding was lower in the study group than in the control group ($p = 0.040$). The infants' oxygen saturation values were significantly higher during feeding in the study group than in the control group ($p = 0.036$). During feeding, heart rate was lower in the study group than in the control group ($p = 0.045$). The data are shown in Table 2.

The mean gastric residual volumes of preterm infants in the study and control groups were 0.73 ± 1.07 ml (range, 0–3; median = 0) and 0.87 ± 1.54 ml (range, 0–6; median = 0.3), respectively. The difference was not statistically significant ($p = 0.807$).

## Discussion

This study evaluated the effects of the fixed time and gravity feeding methods on respiratory rate, oxygen saturation, heart rate, and gastric residual volume in preterm infants. The methods used and variables that were monitored in this study were consistent with published literature.

Our results showed that, during the feeding of preterm infants, both respiratory rate and heart rate were lower in the study group than in the control group; oxygen saturation was higher in the study group. The effectiveness of push and gravity feeding methods in enteral feeding were compared in a previous study that examined oxygen saturation and heart rate in preterm infants. The mean feeding duration for both methods was 10 min, and the cardiopulmonary findings of infants placed in the prone position were similar between groups [7]. Khatony et al. [16] reported that the gastric residual volume was lowest when infants were placed in the prone position. In our study, all infants were placed in the prone position; however, there were differences between groups in terms of feeding duration. For infants fed by the gravity method, the mean duration of feeding was 5 min; for infants fed by the fixed-time method, the feeding duration was fixed at 20 min. Due to the infants' slow food intake, oxygen saturation was higher among infants

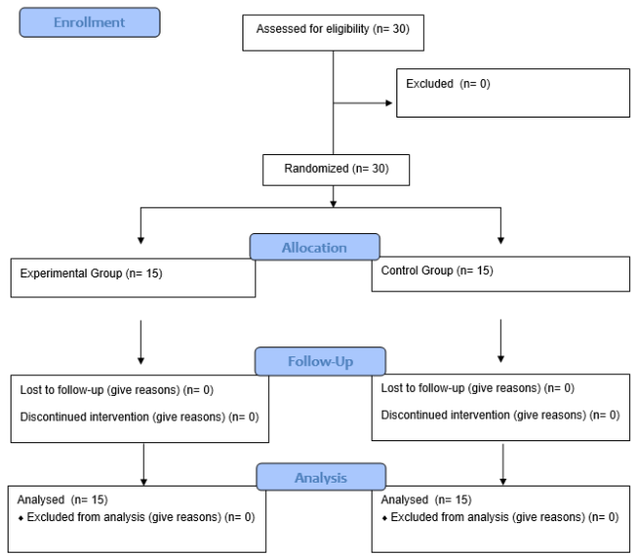


**Figure 1.** Flow diagram of participant enrollment

**Table 1.** Comparison of descriptive characteristics and feeding features in preterm infants between study and control groups

| | | Study Group (n = 15) | Control Group (n = 15) | p |
|---|---|---|---|---|
| Male, n (%) | | 9 (60) | 6 (40) | 0.273[a] |
| Gestational age, (weeks) | | 28.47±1.68 | 27.60±2.10 | 0.223[b] |
| Post-menstrual age, (weeks) | | 30.60±1.64 | 30.93±1.58 | 0.575[b] |
| Birthweight, (grams) | | 1108.00±269.74 | 988.67±309.65 | 0.270[b] |
| Weight, (grams) | | 1156.93±239.12 | 1169,67±229.93 | 0.883[b] |
| Length of orogastric tube, (cm) | | 15.73±1.03 | 15.33±1.11 | 0.316[b] |
| Amount of food, (ml) | | 17.67±5.92 | 17.20±6.68 | 0.841[b] |
| Breastfeeding | | 11 (73.3) | 10 (66.7) | 1.000[c] |
| Respiratory Support | None | 8 (53,3) | 5 (33,3) | 0.582[d] |
| | Free $O_2$ | 3 (20.0) | 5 (33,3) | |
| | NIPPV | 1 (6.7) | 2 (13,3) | |
| | CPAP | 3 (20.0) | 3 (20.0) | |

[a] Pearson's Chi-square test; [b] Student t test; [c] Fisher's Exact test; [d] Fisher Freeman Halton Exact test, NIPPV: nasal intermittent positive pressure ventilation; CPAP: continuous positive airway pressure

**Table 2.** Comparison of respiratory rate, oxygen saturation and heart rate in preterm infants between study and control groups

| | Study Group (n = 15) | Control Group (n = 15) | p |
|---|---|---|---|
| Respiratory Rate | | | |
| Before feeding | 48.77±7.03 | 54.95±12.18 | 0.100 |
| During feeding | 50.98±7.80 | 57.29±8.46 | 0.040 |
| After feeding | 50.01±7.76 | 55.61±7.83 | 0.059 |
| Oxygen Saturation | | | |
| Before feeding | 96.05±1.57 | 94,89±2,63 | 0.151 |
| During feeding | 95.95±1.61 | 94,36±2,29 | 0.036 |
| After feeding | 95.68±2.04 | 94,41±2,23 | 0.113 |
| Heart Rate | | | |
| Before feeding | 145,15±10,97 | 146,85±8,68 | 0.640 |
| During feeding | 145,74±10,95 | 153,36±8,84 | 0.045 |
| After feeding | 146,12±13,98 | 149,33±10,67 | 0.484 |
| Student t-test | | | |

fed by the fixed-time method.

Another study comparing push and gravity feeding methods found that the respiratory rates of infants fed by the push feeding method were high at 10–30 min after feeding, whereas the heart rate was high among infants fed by the gravity feeding method; however, that study did not report the duration of feeding [8]. In the present study, respiratory and heart rates were significantly lower in infants fed by the fixed-time method than in infants fed by the gravity method; both rates remained lower within 15 min after feeding, although the difference was not statistically significant at this time point. These results are presumably related to the slower transport of food to the infant's stomach using the fixed-time method, compared with the gravity method. The distance of the tube between the stomach and the injector was 15 cm, which corresponds to the distance reported in the literature [7].

In the present study, gastric residual volume did not significantly differ between groups. In a randomized controlled trial, gastric residual volume in preterm infants was lower in the gravity feeding group (food was administered within 15 min) than in the semi-continuous feeding group (one-quarter of the hourly feeding amount was provided by gravity at 15-min intervals throughout the day) [6].

A limitation of our study was its small sample size, although this size was determined via power analysis. In addition, the results were measured after a single meal. The findings of our study are limited to the clinic where the research was conducted.

## *Conclusions*

Our study showed lower respiratory and heart rates, and higher oxygen saturation, in infants fed by the fixed-time method than by the gravity method during feeding. Thus, the fixed-time method may suggest for use by healthcare professionals during treatment of preterm infants. Our results should be confirmed in studies with larger sample sizes and after administration of more than one meal. They also require validation according to additional physiological variables, anthropometric measurements, and feeding tolerance during transition to full oral feeding.

***Scientific Responsibility Statement***

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

***Animal and human rights statement***

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

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***Conflict of interest***

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***References***

*1. Chawanpaiboon S, Vogel JP, Moller AB, Lumbiganon P, Petzold M, Hogan D, et al. Global, regional, and national estimates of levels of preterm birth in 2014: a systematic review and modelling analysis. Lancet Glob Health. 2019;7(1):e37-46.*

*2. Sánchez-Tamayo T, Espinosa Fernández MG, Affumicato L, López MG, Romero VF, Algarra MCM, et al. Reduction of enterocolitis with an enteral nutrition protocol in preterm newborns. An Pediatr. 2016;85(6):291-9.*

*3. Bozzetti V, Tagliabue PE. Enteral nutrition for preterm infants: by bolus or continuous? An update. La Pediatria Medica e Chirurgica. 2017;39(2):67-70.*

*4. Corvaglia L, Martini S, Aceti A, Capretti MG, Galletti S, Faldella G. Cardiorespiratory events with bolus versus continuous enteral feeding in healthy preterm infants. J Pediatr. 2014;165(6):1255-7.*

*5. Richards R, Foster JP, Psaila K. Continuous versus bolus intragastric tube feeding for preterm and low birth weight infants with gastro□oesophageal reflux disease. Cochrane Database Syst Rev. 2014;17(7): CD009719.*

*6. Rövekamp-Abels LW, Hogewind-Schoonenboom JE, de Wijs-Meijler DP, Maduro MD, Jansen-van der Weide MC, van Goudoever JB, et al. Intermittent bolus or semicontinuous feeding for preterm infants? J Pediatr Gastroenterol Nutr. 2015;61(6):659-64.*

*7. Joshi R, van Pul C, Sanders A, Weda H, Bikker JW, Feijs L, et al. A strategy to reduce critical cardiorespiratory alarms due to intermittent enteral feeding of preterm neonates in intensive care. Interact J Med Res. 2017;6(2):e20.*

*8. Dawson JA, Summan R, Badawi N, Foster JP. Push versus gravity for intermittent bolus gavage tube feeding of premature and low birth weight infants. Cochrane Database Syst Rev. 2012;11:CD005249.*

*9. Lucas A, Bloom SR, Aynsleygreen A. Gut hormones and "minimal enteral feeding". Acta Paediatrica Scandinavica. 1986;75:719-23.*

*10. Gazzaneo MC, Suryawan A, Orellana RA, Torrazza RM, El-Kadi SW, Wilson FA, et al. Intermittent bolus feeding has a greater stimulatory effect on protein synthesis in skeletal muscle than continuous feeding in neonatal pigs. J Nutr. 2011;141(12):2152-8.*

*11. Wang Y, Zhu W, Luo BR. Continuous feeding versus intermittent bolus feeding for premature infants with low birth weight: a meta-analysis of randomized controlled trials. Eur J Clin Nutr. 2019;74(5):775-83.*

*12. Özdel D, Sarı HY. Effects of the prone position and kangaroo care on gastric residual volume, vital signs and comfort in preterm infants. Jpn J Nurs Sci. 2020;17(1):e12287.*

*13. Dani C, Pratesi S, Barp J, Bertini G, Gozzini E, Mele L, et al. Near-infrared spectroscopy measurements of splanchnic tissue oxygenation during continuous versus intermittent feeding method in preterm infants. J Pediatr Gastroenterol Nutr. 2013;56(6):652-6.*

*14. Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. Trials. 2010;11(1):1-8.*

*15. Kundt G. A new proposal for setting parameter values in restricted randomization methods. Methods Inf Med. 2007;46(4):440-9.*

*16. Khatony A, Abdi A, Karimi B, Aghaei A, Brojeni HS. The effects of position on gastric residual volume of premature infants in NICU. Ital J Pediatr. 2019;45(1):6.*

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