Received: 26 August 2024 | Revised: 10 March 2025 | Accepted: 22 March 2025

DOI: 10.1111/jjns.70009

ORIGINAL ARTICLE

JAPAN JOURNAL OF NURSING SCIENCE WILEY

Effect of premature infant oral motor intervention (PIOMI) and pacifier intervention on the transition to oral feeding in preterm infants: A randomized controlled study

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Funding information
Bilimsel Araştırma Projeleri, Erciyes Üniversitesi, Grant/Award Number: TDK-2022-11507

Abstract

Aim: This study aimed to evaluate the effect of premature infant oral motor intervention (PIOMI) and pacifier intervention on the transition to full oral feeding in preterm infants.

Methods: This is a randomized controlled trial conducted between January 2021 and April 2023 in a neonatal intensive care unit in Eskişehir, Turkey. Preterm infants born between 29 and 34 weeks of gestation were included in the study. Infants were assigned to the groups by stratified randomization method. The study was completed with a total of 39 infants, 13 infants in each group (PIOMI, pacifier, and control). Data were collected using the "Preterm Infant Demographic Information Form," "Feeding Monitor Form," and "Early Feeding Skills Assessment Tool (EFS)." Statistical analysis used paired sample t-tests, ANOVA, Wilcoxon, Kruskal–Wallis H, and Pearson-χ^2 test methods.

Results: In the research findings, it was determined that infants receiving PIOMI and pacifier intervention had a shorter length of stay, transition to full oral feeding compared to infants in the control group, and consumed a higher amount of feed in the first minute ($p < .05$). The infants in the PIOMI group started full oral feeding on average 3 days earlier than the infants in the pacifier group and were discharged approximately 4 days earlier ($p > .05$). It was determined that infants in the PIOMI group had significantly higher EFS-total compared to infants in the control group.

Conclusions: PIOMI intervention and pacifier intervention should be included in nursing care in neonatal intensive care units to improve the oral feeding skills of preterm infants and shorten their discharge time.

KEYWORDS
feeding, infant, pacifiers, stimulation

Clinical trial registration number: NCT05310851.

1 | INTRODUCTION

Every year, 5–18% of infants worldwide are born prematurely (WHO, 2022). According to the data from the Turkish Statistical Institute (TUIK) in 2018, the rate of preterm births in Turkey was 12% (TUIK, 2018). With advancements in scientific and technological knowledge in neonatology, a significant portion of preterm infants can now be saved (Darmaun et al., 2018; Hee Chung et al., 2020). However, these infants are still exposed to many challenges that can negatively affect their growth.

One of the most significant problems exposed by preterm infants is difficulty in oral feeding. Adequate function and coordination of many factors such as oral-motor structure, cardiorespiratory system, and postural control are required for effective and safe oral feeding (Rhooms et al., 2019). Feeding problems arise in preterm infants because they are physiologically and neurologically immature, have poor oral-motor reflexes, cannot coordinate sucking, swallowing, and breathing, cannot maintain flexion posture during feeding, can remain awake for a short time, and cannot maintain normal physiologic values during feeding. Therefore, until the structures necessary for oral feeding develop, preterm infants are fed parenterally and via gavage in neonatal intensive care units (NICU). While parenteral and gavage feeding ensures nutrient intake, it lacks the advantages of oral feeding such as taste perception, sucking reflex, and oral stimulation. Additionally, it can serve as a route for infectious agents. This emphasizes the importance of preterm infants transition to full oral feeding as quickly as possible (Ghomi et al., 2019). The American Academy of Pediatrics (AAP) also recommends full oral feeding as a criterion for discharge (AAP, 2008). Therefore, the discharge of infants who cannot transition to oral feeding is delayed. Prolonged hospital stays expose infants to adverse conditions in the intensive care unit and infectious agents for a longer period (Fucile et al., 2012; Gözen & Girgin, 2017).

More than 30% of preterm infants experience difficulty transitioning from gavage feeding to oral feeding (Lima et al., 2015). To facilitate the transition to full oral feeding, interventions aimed at improving oral feeding skills are applied. One of these interventions is premature infant oral motor intervention (PIOMI). It consists of massages aimed at strengthening the cheeks, lips, gums, and tongue for the first 3 min, followed by nonnutritive sucking for the last 2 min (Lessen, 2008). Rhythmic stimulations applied to infants improve the coordination of the muscles of the tongue, lips, and cheeks and strengthen muscles around the mouth and in the oral cavity, making sucking and swallowing functions more efficient (Ghomi et al., 2019). Studies have shown that PIOMI increases weight gain and oral intake in preterm infants (Arora et al., 2018; Knoll et al., 2019), reduces transition time to full oral feeding, and hospital stays (Arora et al., 2018; Lessen et al., 2015).

PIOMI requires specialized training and certification. Therefore, it may not be possible for every nurse to apply it. In such cases, alternative methods supporting oral feeding that can be applied by every nurse may be needed. Due to its ease of application, lack of professional training requirements, and low clinical and financial burden, pacifier intervention has been considered as an alternative. Pacifier use, a nonnutritive sucking method, is considered a part of developmental care (Yildiz et al., 2021). Studies support pacifier use in preterm infants for its many physiological benefits such as digestion, behavioral organization, pain management, motor function, and sucking development (Fucile et al., 2021; Lubbe & ten Ham-Baloyi, 2017). Besides, pacifier use is reported to increase the tension in the upper airway muscles with continuous sucking and protect the airway by keeping the tongue in a forward position (Yildiz et al., 2021). A study (Dur & Gözen, 2021) determined that preterm infants who were given pacifiers had higher food intake percentages and shorter feeding times. In another study (Yildiz & Arikan, 2012), preterm infants who were given pacifiers switched to oral feeding in a shorter time.

However, there is a lack of studies comparing these two methods in the literature. The aim of this study is to evaluate the effect of PIOMI and pacifier intervention on the transition to full oral feeding in preterm infants. It is anticipated that the results will provide guidance on whether nurses can use a pacifier when they are unable to apply PIOMI.

1.1 | Research hypotheses

$H1_1$. The transition to full oral feeding is shorter in preterm infants who receive PIOMI compared to those who receive pacifier intervention.

$H1_2$. The discharge time is shorter in preterm infants who receive PIOMI compared to those who receive pacifier intervention.

$H1_3$. The EFS total score is higher in preterm infants who receive PIOMI compared to those who receive pacifier intervention.

2 | MATERIALS AND METHODS

2.1 | Study design

This was a randomized controlled experimental clinical study conducted in an NICU in Eskişehir, Turkey.

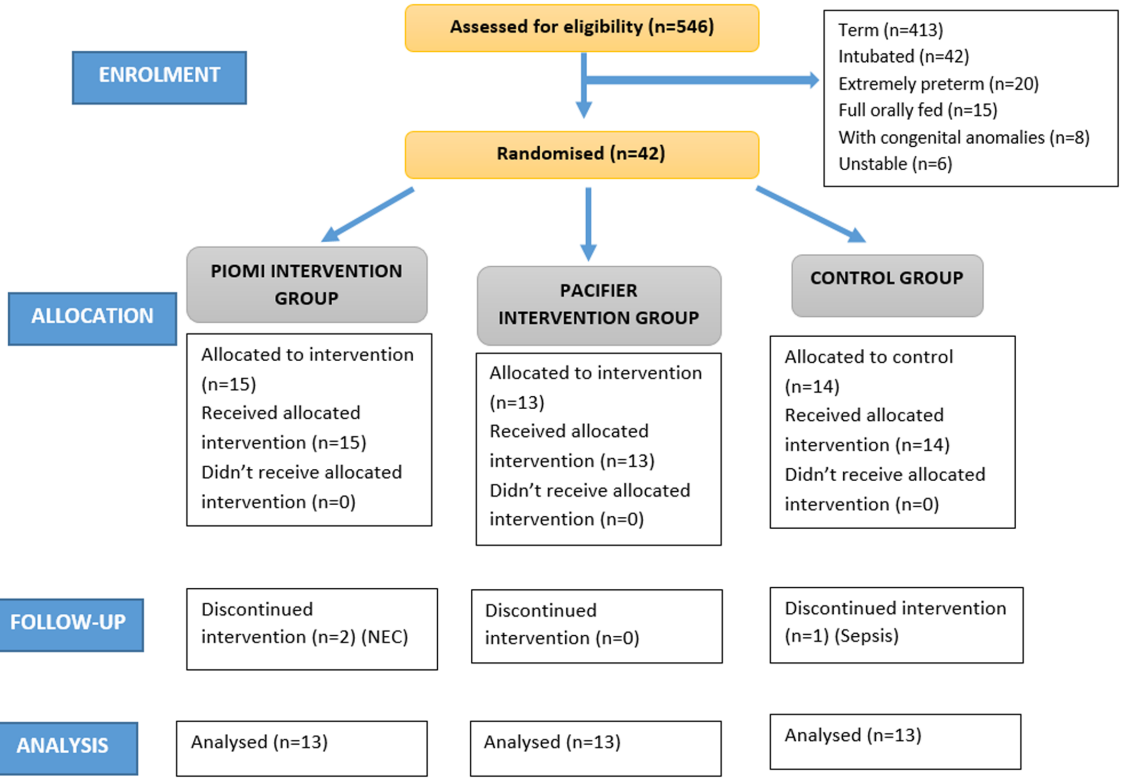

FIGURE 1 CONSORT flow diagram.

The study population consisted of preterm infants born between 29 and 34 gestational weeks (based on mothers' last menstrual periods) and hospitalized to the unit during the study period (January 2021–April 2023) ($N = 546$).

The sample size for the study was determined based on power analysis conducted with $\beta = 0.05$, $\alpha = 0.05$, and power of 0.95, utilizing parameters related to the transition to oral feeding from similar studies in the literature (Asadollahpour et al., 2015; Zhang et al., 2014). Based on the power analysis, a total of 39 infants were included in the study, with 13 infants in each group. Stratification was performed based on the infants' gestational age, birth weight, and postnatal age. The infants were divided into two groups as "29–31 weeks" and "32–34 weeks" according to gestational age, into three groups as "1000 g-1499 g," "1500 g-1999 g," and "2000 g-2500 g" according to birth weight, and into two groups as "2–3 days" and "4–5 days" according to postnatal age. In accordance with this stratification, a randomization list was generated using a computer program. After their admission, the infants were evaluated according to the inclusion criteria. Once it was decided to include them, they were assigned to the appropriate group according to the list, considering their gestational age, birth weight, and postnatal age.

Upon completion of the data collection process, a power analysis was conducted using G*Power 3.0.10 software. With 13 participants per group, three groups, and a repeated measures design, the study's power was determined to be 90.6% with a 5% error margin and an effect size of $f = 0.20$.

The CONSORT (Boutron et al., 2017) flow diagram for the study is presented in Figure 1.

2.2 | Inclusion criteria

Infants born between 29 and 34 gestational weeks based on the mother's last menstrual period,
Postnatal age between 2 and 5 days,
Stable vital signs for at least 24 h,
Apgar scores of 4 or higher at 1 and 5 min,
Written and verbal consent were obtained from parents.

2.3 | Exclusion criteria

Infants already on full oral feeding,
Infants with congenital anomalies,
Infants developing necrotizing enterocolitis,

Infants with intraventricular hemorrhage,
Infants receiving respiratory support other than high-flow nasal cannula,
Infants experiencing any complications resulting in physiological imbalance during the follow-up period after inclusion in the study.

2.4 | Data collection tools

2.4.1 | Preterm Infant Demographic Information Form

This form, created by the researcher, collects identifying characteristics of the infant (such as name, gender, date of birth, gestational age, Apgar score, birth weight, mode of delivery, nutritional content, hospitalization date to the NICU, group assignment). This form was completed by the researcher based on the information obtained from the patient file.

2.4.2 | Feeding Monitor Form

This form, created by the researcher, records the daily feeding intake of infants. It includes information on oral and gavage feeding amounts at two times of the day (09:00 a.m. and 09:00 p.m.), amount consumed per minute if oral feeding occurred, feeding content, and any feeding complications. This form was completed by the researcher.

2.4.3 | Early Feeding Skills Assessment Tool (EFS-Turkish)

This tool is used to assess the oral feeding skills of preterm infants and their readiness for oral feeding transition. It was developed by Thoyre et al. in 2005 and revised by Thoyre in 2018. The Cronbach's alpha value for the total EFS is 0.81 (Thoyre et al., 2005; Thoyre et al., 2018). The Turkish validity and reliability of the scale were established by Aykanat-Girgin et al. in 2021. The Cronbach's alpha value for the total EFS of the Turkish scale is 0.95. It consists of 19 items and five subdimensions: respiratory regulation (items 1, 2, 3, 4, 5), oral-motor function (items 6, 7, 8, 9), swallowing coordination (items 10, 11, 12, 13), engagement in feeding (items 14 and 15), and physiological stability (items 16, 17, 18, 19). Each item is scored as 1, 2, or 3 points, indicating the lowest skill level or problem frequency (1 point), emerging/occasional skills or problems (2 points), or matured skill or absence of problem (3 points). The overall EFS score is the sum of the five subscale scores and ranges between 19 and 57. The scale does not have a cutoff point. Higher scores indicate more mature feeding skills (Girgin et al., 2021). In this study, the Cronbach's alpha value for the total EFS was found to be 0.72. This scale was completed by the infant's nurse during that shift. At this stage, the blinding method was used, and the nurse filled out the scale without knowing which group the infant was in.

2.5 | Primary outcomes

The primary outcomes of this study were the time to transition to full oral feeding and discharge times.

2.6 | Secondary outcomes

Secondary outcomes of the study were EFS scores and the amount consumed in the first 1 min of oral feeding.

2.7 | Blinding

This study was a single-blinded, randomized controlled trial. The intervention was applied by the researcher. Neonatologists making decisions regarding the transition to oral feeding and discharge, and nurses conducting the EFS assessment were blinded to the intervention.

2.8 | Intervention

Before deciding on the method and duration of pacifier intervention, studies that implemented it and reported its effectiveness were reviewed (Calik & Esenay, 2019; Dur & Gözen, 2021; Kaya & Aytekin, 2017; Zhang et al., 2014). Among the pacifier methods used in these studies, the one that showed similarity in terms of duration to PIOMI intervention was selected (Dur & Gözen, 2021). A pacifier intervention lasting a total of 5 minutes was performed, divided into 3 minutes given 1 hour before feeding and 2 minutes given 10 minutes before feeding. This intervention was applied once daily for 14 consecutive days. Each infant had their own pacifier, and the same type of pacifier (premature infant pacifier) was used for the intervention. PIOMI is a total of 5 min, with the first 3 min consisting of massages aimed at strengthening the cheeks, lips, gums, and tongue, and the last 2 min consisting of nonfeeding sucking.

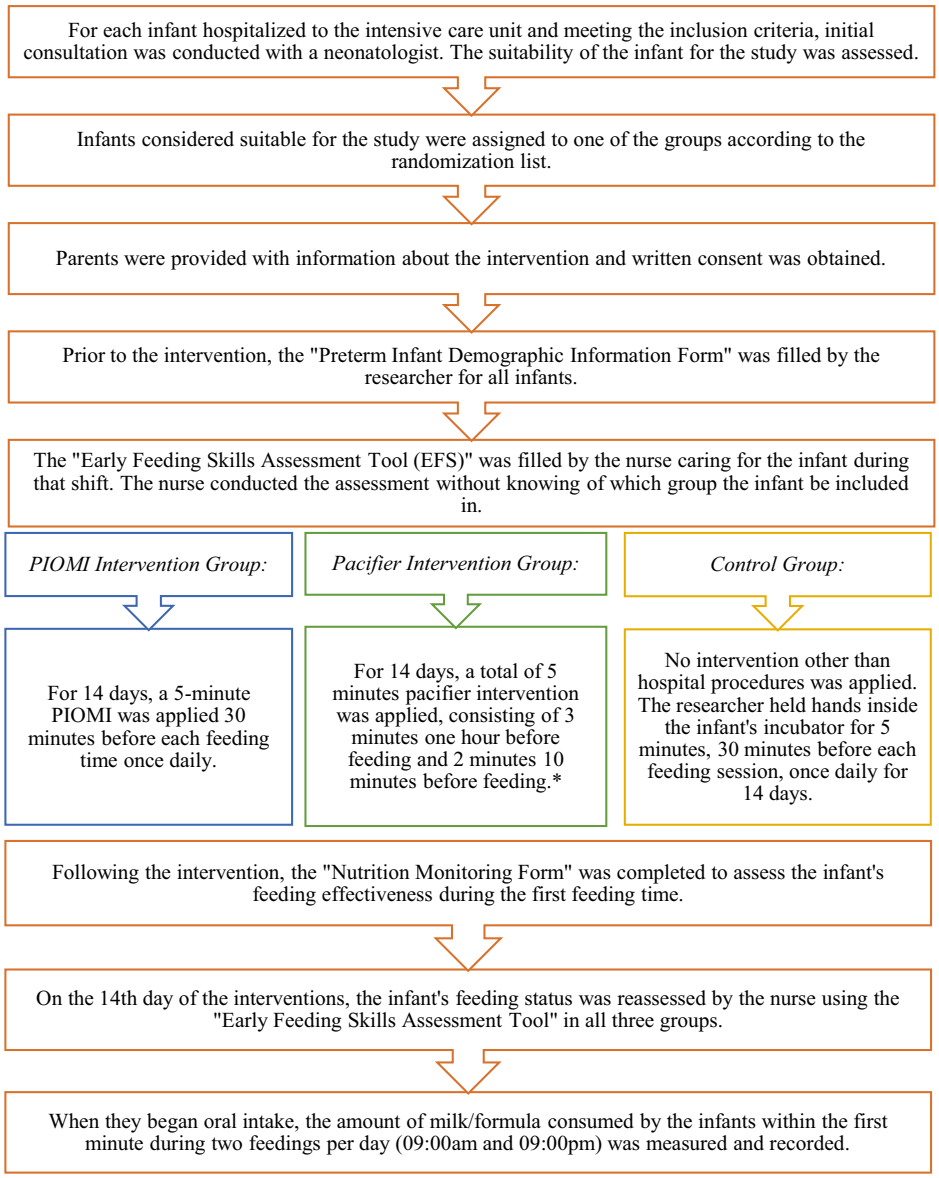

FIGURE 2 Process intervention steps.

PIOMI was applied to the infants once daily, half an hour before feeding, for 14 consecutive days. A certification is required to apply PIOMI, and therefore, prior to the study, the first author obtained certification in this area. Process implementation steps are given in Figure 2.

All interventions were applied to the infants in all three groups before the 09:00 a.m. feeding. As the nurses conducting the scale assessment and the neonatologist making decisions regarding the transition to oral feeding and discharge were blinded to the intervention, the interventions were applied while there was a blanket on the incubator. During PIOMI and pacifier interventions, if any negative physiological or behavioral case was observed in the infant, the intervention was terminated. If the infant's condition was stable before the next feeding time, the intervention was reattempted.

2.9 | Ethical considerations

This study was performed in line with the principles of the Declaration of Helsinki. The research was approved by the Ethics Committee of Eskisehir Osmangazi University (2021/172144). The mother of the infant gave informed consent to participate in the study, and they had the right to withdraw from the study before data analysis with no damage.

2.10 | Statistical analyses

Statistical analyses were conducted using computer software. Frequency tables and descriptive statistics were utilized for interpreting the findings. Data showing normal

TABLE 1 Some demographic characteristics of infants.

	PIOMI intervention group ($n = 13$)		Pacifier intervention group ($n = 13$)		Control group ($n = 13$)		Statistic[a]
Variable	***n***	**%**	***n***	**%**	***n***	**%**	***p***
Gender							
Girl	6	46.2	7	53.8	6	46.2	$\chi^2 = 0.205$ $p = .902$
Boy	7	53.8	6	46.2	7	53.8	
Gestational Age (week)							
29–31	4	30.8	4	30.8	4	30.8	$\chi^2 = 0.000$ $p = 1.000$
32–34	9	69.2	9	69.2	9	69.2	
Postnatal Age (day)							
2–3	5	38.5	5	38.5	5	38.5	$\chi^2 = 0.000$ $p = 1.000$
4–5	8	61.5	8	61.5	8	61.5	
Mode of Delivery							
Cesarean delivery	12	92.3	12	92.3	12	92.3	$\chi^2 = 0.000$ $p = 1.000$
Vaginal delivery	1	7.7	1	7.7	1	7.7	
Nutritional Content							
Breast milk + formula	13	100.0	13	100.0	13	100.0	#

[a]Pearson-χ^2.

distribution were analyzed using the paired sample test (t-table value) for comparing two dependent groups, while the ANOVA test (F-table value) for comparing three or more independent groups. Data not showing normal distribution were analyzed using the Wilcoxon test (Z-table value) for comparing measurement values of two dependent groups, and the Kruskal–Wallis H test (χ^2-table value) for comparing three or more independent groups. Pearson-χ^2 contingency tables were utilized for examining the relationships between two categorical variables. Cohen's d and 95% confidence intervals were used for assessing effect size, while eta squared was examined for effect size evaluation.

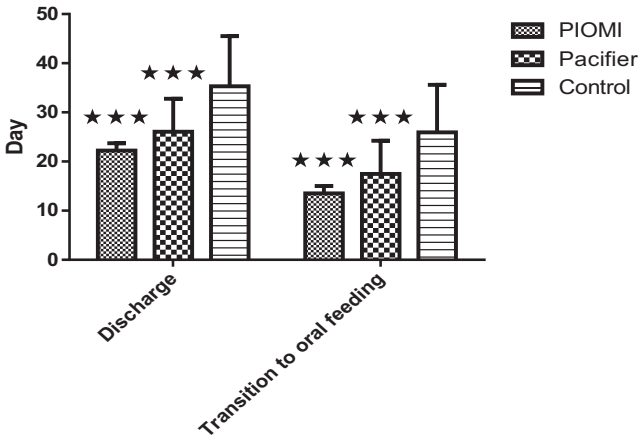

FIGURE 3 Discharge and transition to oral feeding times of infants by groups.

3 | RESULTS

When examining the similarity between groups in terms of infant demographic characteristics, there was no statistically significant difference found ($p > .05$). Some demographic characteristics of the groups are presented in Table 1.

It was found that there was a significant difference between the groups in terms of the transition time to oral +orogastric (OG) feeding (days), transition time to full oral feeding (days), length of hospital stay, and the amount consumed in the first 1 min of oral feeding (cc). It was determined that infants who received PIOMI and pacifier intervention had significantly shorter transition times to oral+OG feeding (days), transition times to full oral feeding (days), and length of hospital stay compared to infants in the control group (Figure 3). Additionally, the amount consumed in the first 1 min was found to be significantly higher in infants who received PIOMI and pacifier intervention compared to infants in the control group. No significant difference was found between the PIOMI and pacifier groups. However, the transition time to oral feeding and discharge time of the PIOMI group infants were shorter than those in the pacifier group. The

TABLE 2 Post-intervention discharge and oral feeding characteristics of infants.

Variables	PIOMI intervention group (1) ($n = 13$)		Pacifier intervention group (2) ($n = 13$)		Control group (3) ($n = 13$)		
	$\overline{X} \pm SD$	Median [IQR]	$\overline{X} \pm SD$	Median [IQR]	$\overline{X} \pm SD$	Median [IQR]	Statistic[a] p
Transition time to oral+OG feeding (day)	5.23 ± 4.04	4.0 [4.5]	8.23 ± 4.49	8.0 [5.5]	14.69 ± 5.73	15.0 [8.5]	$\chi^2 = 16.382$ **$p < .001$** **[1 < 3]** **[2 < 3]**
Transition time to full oral feeding (days)	13.53 ± 5.26	13.0 [9.5]	17.46 ± 6.78	17.0 [12.0]	25.93 ± 9.69	24.0 [16.0]	F = 9.312 **$p < .001$** **[1 < 3]** **[2 < 3]**
Length of hospital stay (day)	22.23 ± 5.35	20.0 [10.0]	26.07 ± 6.69	26.0 [14.0]	35.31 ± 10.21	35.0 [14.0]	$\chi^2 = 12.562$ **$p = .002$** **[1 < 3]** **[2 < 3]**
The amount consumed in the first 1 min of oral feeding (cc)	11.37 ± 1.13	11.1 [1.6]	10.48 ± 0.85	10.5 [0.7]	8.51 ± 0.84	8.4 [1.6]	F = 31.089 **$p < .001$** **[1 >3]** **[2 > 3]**

Abbreviation: IQR: interquartile range, (Q3 – Q1).
[a]ANOVA (F), Kruskal–Wallis H (χ^2).

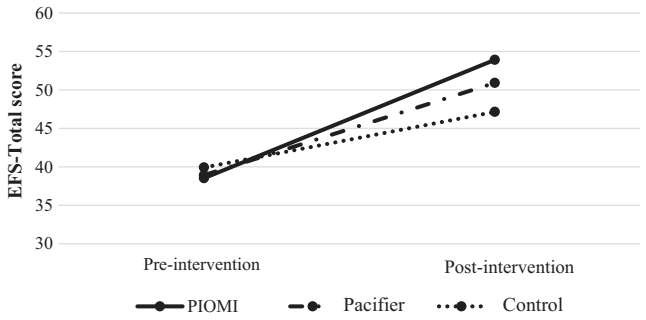

FIGURE 4 Distribution of infants' EFS total scores in terms of groups and processes.

amount consumed in the first 1 min was also higher in the PIOMI group than in the pacifier group (Table 2).

In the intra-group comparison of infants' pre-intervention to post-intervention EFS total scores, it was determined that post-intervention EFS total scores were significantly higher in all three groups ($p < .001$). When the effect sizes of pre-intervention to post-intervention effect intra-group analyses were examined, it was found that the group receiving PIOMI showed the highest results (Figure 4).

In the intergroup comparison, a statistically significant difference was found in terms of infants' post-intervention EFS total scores (F = 9.072; $p < .001$). It was determined that the post-intervention EFS total scores of infants receiving PIOMI were significantly higher than those of the control group (Table 3). When the post-intervention EFS-subscale scores of infants were examined, it was found that, except for engagement, the subscale scores were significantly higher in infants receiving PIOMI compared to those in the control group. No significant difference was found between the infants in the PIOMI and pacifier groups in terms of EFS total scores ($p > .05$). However, the EFS total scores of the infants in the PIOMI group were higher than those in the pacifier group.

4 | DISCUSSION

The study aimed to evaluate the effect of PIOMI and pacifier intervention on the transition to full oral feeding in preterm infants. It was concluded that infants who received PIOMI and pacifier intervention had shorter times for both Oral+OG and full oral feeding transitions compared to infants in the control group ($p < .001$) (Table 2). Similarly, in the literature (Guler et al., 2022; Lessen, 2011; Pruksadee et al., 2017; Sasmal et al., 2023; Thabet & Sayed, 2021; Thakkar et al., 2018), it has been found that infants who applied PIOMI had shorter times for full oral feeding transitions compared to infants in the control group. In the literature review, no study was found to show that PIOMI was ineffective in the transition to oral feeding. These findings support that PIOMI is

TABLE 3 Inter- and intragroup comparison of infants' pre- and post-intervention EFS total scores.

	PIOMI intervention group (1) ($n = 13$)		**Pacifier intervention group (2) ($n = 13$)**		**Control group (3) ($n = 13$)**			
EFS total score	$\overline{X} \pm SD$	**Median [IQR]**	$\overline{X} \pm SD$	**Median [IQR]**	$\overline{X} \pm SD$	**Median [IQR]**	**Statistic[a] *p***	**Effect (η^2)**
Pre-intervention	38.53 ± 5.47	38.0 [9.5]	38.92 ± 5.82	39.0 [7.5]	39.92 ± 5.27	39.0 [9.5]	F = 0.142 $p = .868$	*0.008*
Post-intervention	53.92 ± 2.81	55.0 [4.0]	50.92 ± 4.13	51.0 [5.0]	47.15 ± 4.95	48.0 [8.5]	F = 9.072 **$p < .001$** **[1 > 3]**	*0.335*
Statistic[a]	$t = -9.996$		$t = -10.873$		Z = -3.187			
p	**$p < .001$**		**$p < .001$**		**$p = .001$**			
Effect *(d)*	*5.050*		*3.979*		*3.780*			

Abbreviation: IQR: Interquartile range, (Q3 – Q1).
[a]Paired sample test (t), ANOVA (F), Wilcoxon (Z).

an effective intervention to improve the feeding performance of preterm infants. The aim of oral motor stimulation interventions such as PIOMI is to strengthen the oral motor functions of preterm infants and to create sufficient sucking power (Fucile et al., 2012). In addition, oral motor stimuli are believed to help sucking skills and coordination between sucking, swallowing, and breathing by strengthening the development of central and peripheral structures (Gözen & Girgin, 2017).

A meta-analysis study (Tolppola et al., 2022) determined that infants using pacifiers transitioned to full oral feeding 3 days earlier. In the study by Say et al. (2018), infants using pacifiers transitioned to oral feeding 11 days earlier than infants in the control group (Say et al., 2018). The use of a pacifier during the first transition to oral feeding in preterm newborns stimulates the sucking reflex of the newborn, supports sucking-swallowing skills, and ensures readiness for feeding. It facilitates sucking–swallowing–respiratory coordination during the oral feeding process (Dur & Gözen, 2021). This study's findings are consistent with the literature, showing that infants receiving PIOMI transitioned to full oral feeding an average of 12 days earlier than the control group, while infants using pacifiers transitioned an average of 8 days earlier.

It was concluded that the length of hospital stay for infants who received PIOMI and pacifier intervention was shorter than that of the control group ($p = .002$) (Table 2). In a study by Thakkar et al. (2018), preterm infants in the PIOMI group were found to stay in the hospital an average of 2.76 days less than infants in the control group (Thakkar et al., 2018). Similarly, Ghomi et al. (2019) found that infants who received PIOMI were discharged from the hospital on average 9.47 days earlier than infants in the control group (Ghomi et al., 2019). However, some studies using oral motor stimulation methods different from PIOMI (Bache et al., 2014; Lyu et al., 2014) reported no significant difference in length of hospital stay. These findings may be related to intervention methods and infants' ages.

In a meta-analysis study evaluating pacifier use (Tolppola et al., 2022), it was determined that the hospital stay was 7 days shorter for preterm infants who used pacifiers. Similar findings of shorter hospital stays were reported in other studies that examined pacifier use (Calik & Esenay, 2019; Kaya & Aytekin, 2017; Say et al., 2018; Shaki et al., 2022). The treatment and care of preterm infants is a significant burden on healthcare workers and healthcare institutions, as well as parents. Moreover, prolonged hospitalization exposes the infant to negative factors such as infection and painful procedures for a longer period. Separation from the mother in the intensive care unit can also adversely affect both mother–infant bonding and breastfeeding (Li et al., 2020). Therefore, early discharge of the infant is important. Based on the research findings, it is believed that incorporating practices such as PIOMI and pacifier use into nursing care can be beneficial in reducing the length of hospital stay for infants in many ways.

As a result of the study, it was determined that infants who received PIOMI and pacifier intervention consumed a greater amount of nutrients (mL) in the first minute of oral feeding than infants in the control group ($p < .001$) (Table 2). Previous studies have also shown that infants who received PIOMI (Thabet & Sayed, 2021; Thakkar et al., 2018) and pacifier intervention (Dur & Gözen, 2021; Pickler et al., 2012) consumed a greater amount of nutrients than infants in the control group. Examining the effect of a 2-min pacifier application before feeding on the feeding behaviors of infants aged

33–40 weeks, Pickler and Reyna (2004) reported no significant difference between the control group and the pacifier group regarding the percentage of food intake (Pickler & Reyna, 2004).

The first minute of feeding is considered the time with minimal fatigue. The amount of milk consumed during this period is considered an index of preterm infants' actual feeding ability (Lau & Smith, 2011; Li et al., 2020). The higher amount of nutrients consumed in the first minute in the intervention groups indicates the effectiveness of PIOMI and pacifier intervention in improving the oral feeding performance of preterm infants.

It was found that infants who received PIOMI had higher post-intervention EFS total scores than infants in the control group (Table 3). There was no difference in EFS total scores between the pacifier intervention group and the control group. However, the total scores of infants in the pacifier intervention group were higher than those in the control group. In a study by Sasmal et al. (2023), it was also found that the discharge EFS total score was significantly higher in the PIOMI intervention group ($p = .001$) (Sasmal et al., 2023). Similarly, in studies where the PIOMI intervention was evaluated with different measurement tools (Shokri et al., 2023; Sumarni et al., 2021), post-intervention scores were significantly higher in the PIOMI intervention group. Studies evaluating pacifier use with different scales (Bingham et al., 2010; Shaki et al., 2022) have also shown that scores of infants who used pacifiers were significantly higher.

Despite the use of different measurement tools in these studies, the results are similar. Based on these results, it can be concluded that the PIOMI intervention is effective in improving the readiness of preterm infants for oral feeding. However, the pacifier intervention also accelerated the transition to oral feeding compared to the control group. Additionally, no certification is required to administer the pacifier intervention. It can be easily applied by all nurses and even by parents. Therefore, pacifier use is also a beneficial intervention that can be applied by any nurse in intensive care units instead of no intervention.

4.1 | Recommendations

- In order to improve the oral feeding skills of preterm infants and facilitate their early discharge from the hospital, PIOMI and pacifier intervention should be included in the routine care of NICU nurses.
- To support oral feeding in preterm infants, protocols related to these interventions should be established in NICUs to ensure standardization.
- Nurses should be trained in PIOMI application, and their participation in certification programs should be encouraged.
- New studies with larger sample sizes should be planned.
- In new studies, calculating the cost-effectiveness per unit of time for PIOMI and pacifier interventions could assist in medical remuneration decisions and service preferences.

4.2 | Limitations and strengths of the study

Limitations of the study:

- Each time, different nurses provided care and feeding to the infants.
- Each infant was assessed by a different nurse.
- Another weakness of our study was the small sample size.

Despite these limitations, the study also has several strengths. These include:

- The study's stratified randomized controlled design,
- The use of a standardized protocol for both PIOMI and pacifier applications and consistency in terms of duration and method,
- The use of a highly valid and reliable scale, with the blinding method applied in its evaluation,
- Making a unique contribution to the literature as one of the first studies to directly compare PIOMI and pacifier applications.

AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Merve CAKIRLI, Meral BAYAT, and Ayse Neslihan TEKIN. The first draft of the manuscript was written by Merve CAKIRLI, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

FUNDING INFORMATION

This work was supported by Erciyes University Scientific Research Projects Unit (Grant numbers TDK-2022-11507).

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

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How to cite this article: Cakirli, M., Bayat, M., & Tekin, A. N. (2025). Effect of premature infant oral motor intervention (PIOMI) and pacifier intervention on the transition to oral feeding in preterm infants: A randomized controlled study. *Japan Journal of Nursing Science*, *22*(2), e70009. https://doi.org/10.1111/jjns.70009