Research Paper

Prolonged Oral Motor Stimulation Treatment was Effective for Breastfeeding Achievement in Full Term Infants With Feeding Problems

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ABSTRACT

Objectives: Feeding problems can occur in early-term infants born at 37 weeks. Early-term and full-term infants may benefit from oral motor therapy to attain successful breastfeeding. The present study aims to determine the impact of the 5-minute premature infant oral motor intervention (PIOMI) and the 15-minute oral stimulation program (15-minute oral stimulation program) on 37 to 41 weeks infants in attaining successful breastfeeding.

Methods: This clinical trial was conducted on early-term and full-term infants in the neonatal intensive care units (NICUs) of two hospitals in Mashhad City, Iran. They were randomly divided into two intervention groups (5-minute PIOMI or 15-minute oral stimulation program) and one control group (17 infants in each group). These three groups were then compared to each other after the intervention by pediatricians and speech and language specialists regarding their breastfeeding. All statistical analysis was performed using R software, version 4.0.2, and the significance level was set at 0.05.

Results: Infants in both intervention groups attained different levels of breastfeeding compared to pre-intervention. This outcome could be due to our interventions or natural growth and development ($P<0.05$). However, the longer the infants' oral motor therapy time was, the more likely they were to breastfeed successfully. The 15-minute oral stimulation program group had a significantly higher number of male infants attaining breastfeeding after treatment than the control and PIOMI groups ($P=0.03$).

Discussion: The PIOMI has been confirmed as an effective early intervention for small preterm infants as young as 29 weeks, and the short 5-minute therapy time is accepted in the preterm infant population. The program affects the brain's plasticity and improves neurosensory and motor skill development for feeding. The current study indicates that PIOMI remains effective versus the control group in the full-term babies. However, the longer 15-minute oral stimulation program, is more effective in full-term infants. This finding shows that full-term infants can endure and benefit from longer than 5 minutes per day of oral motor therapy.

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Highlights

• Oral motor therapy is appropriate for infants to attain breastfeeding; however, due to the natural growth and development of the infant, some breastfeeding skills are obtained without it.

• Both the 5-minute premature infant oral motor intervention and the 15-minute oral stimulation program have shown their effectiveness in infants; however, the longer the oral motor therapy time the infants had, the more likely they were to breastfeed successfully.

• Our study has shown the effectiveness of the 5-minute and 15-minute treatment protocol for feeding efficiency in infants.

Plain Language Summary

The current study compared the length of therapy on breastfeeding attainment between the 5-minute premature infant oral motor intervention (PIOMI) and 15-minute oral stimulation program in early-term and full-term infants. The results have shown that the infants in the 15-minute oral stimulation program group showed a greater improvement in feeding compared to both the PIOMI and the control groups. The PIOMI group also showed improvements, indicating that both therapies improved feeding skills compared to the control group. These results suggest that the longer treatment of the 15-minute oral stimulation program had a greater effect than the shorter therapy of the 5-minute PIOMI.

Introduction

Feeding behavior development occurs before birth and completes around 34-36 weeks. This pattern includes sucking, swallowing, and breathing [1]. Swallowing is the procedure of transferring food (bolus) from the mouth to the stomach [2]. Its disorders have several possible etiologies, such as neurological disorders, anatomical abnormalities, genetic conditions alone, or their combinations, all of which will lead to nutritional deficits [3]. Studies have shown that nearly 25%-40% of full-term infants and over 80% of early-term infants have some feeding or swallowing dysfunction, mostly colic, vomiting, slow feeding, or denial to eat [4-6]. Feeding and or swallowing difficulties usually subsides as the infant grows older. However, affected full-term infants (gestational age ≥37) who do not improve are at a greater risk of invasive infections such as aspirated pneumonia [4-7]. The main consequence of feeding/swallowing disorders is malnutrition.

There are several ways such as breast, bottle, syringe, tube feeding, and parenteral feeding to feed infants [7]. The skill to suck the nipple of the breast and or suck the tip of a bottle is part of the instincts of the infant [8]. As stated by a 2010 healthy people study, breastfeeding is the best method and should be line up over the other methods; it is vital for both the infant's and the mother's health [9, 10]. The first-week post-natal is the most important period for establishing a healthy breastfeeding routine. As both the mother and the infant are learning how to breastfeed, it is important that it is done correctly and that good habits are known at this stage [9, 11, 12]. If breastfeeding is not done correctly, insufficient milk transmission can cause infant weight loss, dehydration, and serious medical complications such as death [11, 13]. Furthermore, these problems can increase the length of hospitalization, which leads to increased nosocomial infections and potential disabilities, as well as additional financial costs that flare to the parents' anxiety [14-17].

Infants should have well-coordinated sucking, swallowing, and breathing skills [18, 19]. A normal sucking pattern is a constant burst of more than 10 sucks with momentary pauses in between; swallowing and inhalations continuously occur throughout a consecutive pattern [4, 8, 20]. In a prospective study Bingham et al. examined the nonnutritive sucking and feeding skills in premature infants. They found that infants with a correct sucking pattern achieved independent oral feeding 3 days earlier than infants with incorrect sucking patterns [21].

Treatment methods emphasize oral stimulation, nonnutritional sucking, and altering the infant's position during feeding; these treatments should lead to a reduced time to independent oral feeding, increased milk transfer rate, increased weight, and reduced hospitalization time [22-26]. Overall, the main goal of every intervention is to help the infant reach age-appropriate nutritional mile-

stones and to ensure safe swallowing. Several treatments have been studied on infants with feeding/swallowing problems.

Mahmoodi et al. studied the 5-minute premature infant oral motor intervention (PIOMI) to stimulate oral movements in premature infants. Infants who received 5-minute PIOMI demonstrated an earlier onset of oral feeding and reduced hospitalization compared to the control group [1]. In another study, Fucile et al. examined the impact of the 15-minute oral stimulation program on achieving full oral feedings in infants (old enough to tolerate 15 minutes of therapy), who showed substantial feeding improvements [22]. Lessen examined the effects of PIOMI on feeding skill development and the length of hospitalization in preterm infants. Infants who received PIOMI showed improved feeding efficiency, transitioned to full oral feedings earlier than the control group, and had lower hospital stays [15].

The 5-minute PIOMI and 15-minute oral stimulation program are similar in their physical steps. However, the latter has extra steps and takes 15 minutes. Arora et al. showed that the oral stimulation program improves oral motor skills and decreases the transition time from gavage to full independent feeds by mouth in preterm infants [27]. According to Barlow et al., the oral stimulation program significantly increased the proportion of oral nutrients in preterm infants [28].

According to our evaluation, a comprehensive study on the effectiveness of the different treatment techniques in full-term infants at 37 weeks who suffer from feeding/swallowing problems has not yet been done [4, 5]. The short nature of PIOMI has not yet been studied on full-term infants who are poor feeders. Therefore, this study aims to compare the effects of 5-minute PIOMI and the 15-minute oral stimulation program for breastfeeding achievement in full-term infants with feeding problems admitted to the neonatal intensive care units (NICUs).

Materials and Methods

Study design and participants

The study was carried out on 51 full-term infants (26 girls and 25 boys) with a mean age of 37.90 weeks (range 37-39 weeks) at birth and 38.33 weeks (range: 37-41 weeks) at the beginning of the intervention in the NICU wards of Ghaem and Akbar hospitals in Mashhad City, Iran. All full-term infants who participated in this study had feeding/swallowing dysfunctions and difficulty sucking for any reason related to their underlying diseases (such as asphyxia, metabolic diseases, brain disorders, infections, etc.). All parents were thoroughly briefed on the study and gave written consent to study their infants. All infants demonstrated feeding/swallowing disorders, according to the early feeding skills (EFS) screening test [29]. None of the full-term infants have progressive diseases, congenital anomalies (cleft lip and palate), or chromosomal abnormalities. Subjects were excluded from the study if there was a risk of unmanageable harm to the infants and if the parents did not consent. Speech therapists (the first authors of this study) enrolled the participants and assigned them to the interventions.

Assessment techniques

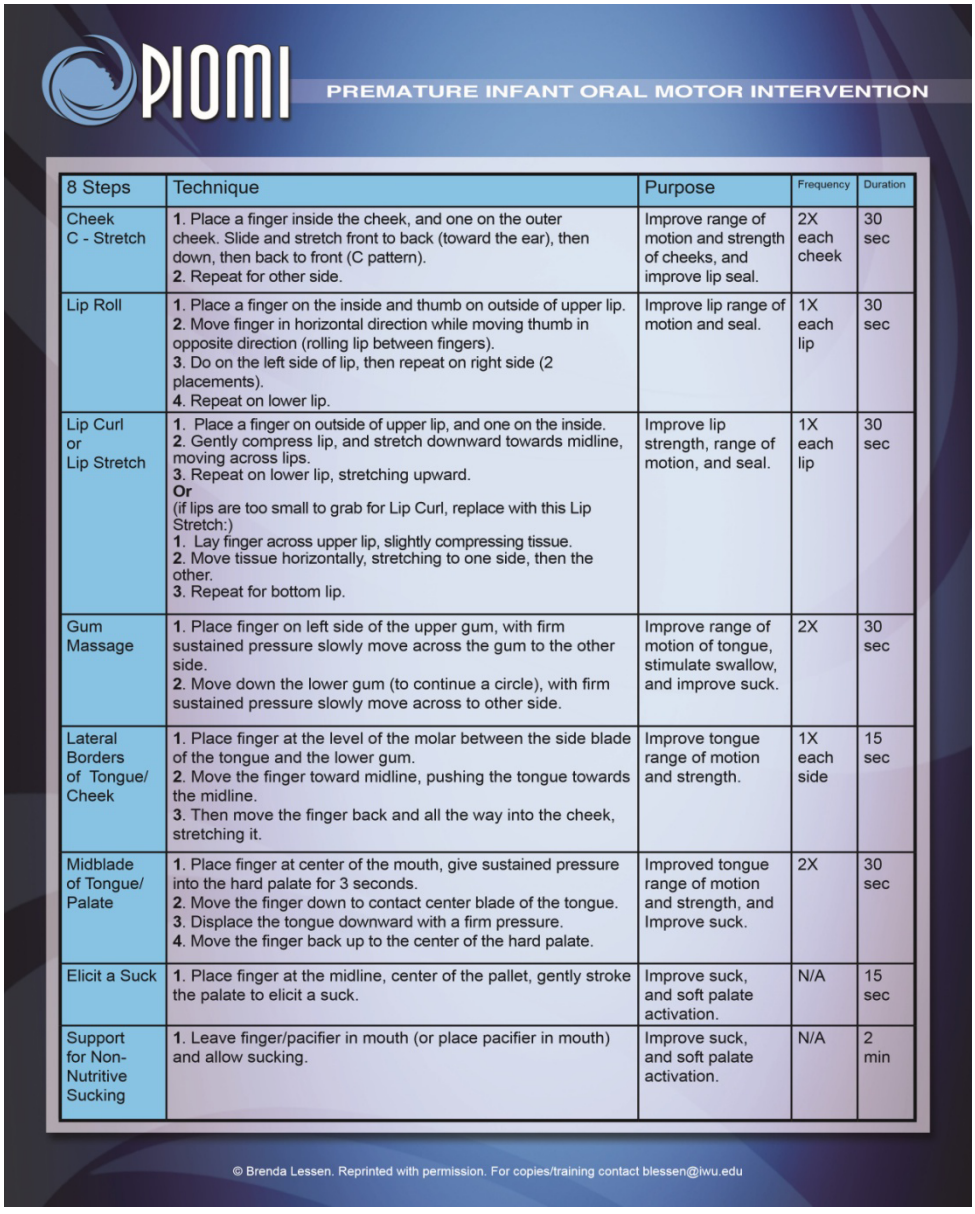
Before and after treatment, the type of feeding method was assessed by a pediatrician, and the infant's swallowing status was evaluated by a speech and language specialist using the EFS screening test [29].

Experimental design

The sample included full-term infants born between 37-39 weeks (mean=37.90) with feeding/swallowing disorders who were randomly assigned using a stratified blocked randomization method by a statistician into three groups of 17 infants each. Two treatment protocols were used to evaluate the effect on infant sucking and swallowing skills. Protocol "A" was the 5-minute PIOMI treatment, and protocol "B" was the 15-minute oral stimulation program. The first group received the "A" protocol, the second group received the "B" protocol, and the control group (group C) received routine care. All NICU personnel (physicians, nurses, etc.) were blinded to group assignment (except the study authors). The intervention was initiated at 37-41 weeks. Each treatment included 7 sessions, and all exercises were performed once a day (in the morning) by one person (the first author). It was stopped if the infants were medically unstable or had any episodes of oxygen desaturations, apnea, or bradycardia during the intervention. After the end of the treatment period, therapeutic advice was given to the parents of the infants in the control group, and routine hospital treatment was continued for all three groups. Infants participating in all three groups were monitored from entry into the study until their discharge from the hospital.

"A" protocol

The 5-minute PIOMI (Figure 1) was used in group A. This program has demonstrated excellent intervention fidelity and is the standard of care for preterm infants



8 Steps	Technique	Purpose	Frequency	Duration
Cheek C - Stretch	1. Place a finger inside the cheek, and one on the outer cheek. Slide and stretch front to back (toward the ear), then down, then back to front (C pattern). 2. Repeat for other side.	Improve range of motion and strength of cheeks, and improve lip seal.	2X each cheek	30 sec
Lip Roll	1. Place a finger on the inside and thumb on outside of upper lip. 2. Move finger in horizontal direction while moving thumb in opposite direction (rolling lip between fingers). 3. Do on the left side of lip, then repeat on right side (2 placements). 4. Repeat on lower lip.	Improve lip range of motion and seal.	1X each lip	30 sec
Lip Curl or Lip Stretch	1. Place a finger on outside of upper lip, and one on the inside. 2. Gently compress lip, and stretch downward towards midline, moving across lips. 3. Repeat on lower lip, stretching upward. **Or** (if lips are too small to grab for Lip Curl, replace with this Lip Stretch:) 1. Lay finger across upper lip, slightly compressing tissue. 2. Move tissue horizontally, stretching to one side, then the other. 3. Repeat for bottom lip.	Improve lip strength, range of motion, and seal.	1X each lip	30 sec
Gum Massage	1. Place finger on left side of the upper gum, with firm sustained pressure slowly move across the gum to the other side. 2. Move down the lower gum (to continue a circle), with firm sustained pressure slowly move across to other side.	Improve range of motion of tongue, stimulate swallow, and improve suck.	2X	30 sec
Lateral Borders of Tongue/ Cheek	1. Place finger at the level of the molar between the side blade of the tongue and the lower gum. 2. Move the finger toward midline, pushing the tongue towards the midline. 3. Then move the finger back and all the way into the cheek, stretching it.	Improve tongue range of motion and strength.	1X each side	15 sec
Midblade of Tongue/ Palate	1. Place finger at center of the mouth, give sustained pressure into the hard palate for 3 seconds. 2. Move the finger down to contact center blade of the tongue. 3. Displace the tongue downward with a firm pressure. 4. Move the finger back up to the center of the hard palate.	Improved tongue range of motion and strength, and Improve suck.	2X	30 sec
Elicit a Suck	1. Place finger at the midline, center of the pallet, gently stroke the palate to elicit a suck.	Improve suck, and soft palate activation.	N/A	15 sec
Support for Non-Nutritive Sucking	1. Leave finger/pacifier in mouth (or place pacifier in mouth) and allow sucking.	Improve suck, and soft palate activation.	N/A	2 min

Figure 1. The PIOMI [30]

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as young as 29 weeks through early infancy [30]. The 5 minutes of therapy has 8 steps to increase motor-oral skills and coordination of sucking, swallowing, and breathing [30] (Table 1). The infants were positioned supine in the isolate. The 5-minute PIOMI was performed for 7 consecutive days and followed by a post-treatment evaluation by the speech therapist using the EFS screening tool.

"B" protocol

The 15-minute oral stimulation program was used in group B. The 15-minute program is used for full-term infants who can tolerate a longer period of therapy than early-term infants [22] (Table 1). The infants were positioned supine in the isolate. These exercises were performed for 7 consecutive days and followed by a post-treatment evaluation by the SLP using the EFS screening tool.

Statistical analysis

All variables were described by descriptive statistics, including mean, median, standard deviation, minimum, and maximum for quantitative variables, as well as frequency and percentage for categorical variables. The normality of variables was assessed by the Shapiro-Wilk test. The homogeneity of the groups in terms of demographic variables was evaluated by the chi-square or Kruskal-Wallis test. The chi-square test using exact P values was used to check the differences between cate-

Table 1. 5-Minute PIOMI and 15-minute oral stimulation program times

PIOMI	Processes	Time (s)
1	Cheek c-stretch	30
2	Lip roll	30
3	Lip curl or lip stretch	30
4	Gum massage	30
5	Lateral borders of tongue/cheek	15
6	Midblade of tongue palate	30
7	Elicit a suck	15
8	Support for nonnutritive sucking	120 Total: 5 minutes

15-minute Oral Stimulation Program	Processes	Time (s)
1	Cheek	120
2	Upper lip	60
3	Lower lip	60
4	Upper and lower lip curl	60
5	Upper gum	60
6	Lower gum	60
7	Internal cheek	120
8	Lateral borders of the tongue	60
9	Midblade of the tongue	60
10	Elicited a suck pacifier	60
11	Place the pacifier in the mouth	180 Total: 15 minutes

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gorical variables across three groups or sub-groups. The within-group differences were evaluated through the marginal homogeneity test. The stratification was used to assess and control for confounding based on gender subgroups or strata. All statistical analysis was performed using R software, version 4.0.2, and the significance level was set at 0.05.

Results

A total of 61 full-term infants were included in the study. Two infants were excluded from the study due to seizures, and 3 due to discontinuing treatment. In addition, 5 infants were excluded from the study due to parental dissatisfaction (Figure 2). In total, 51 term infants completed the study. Table 2 compares age (at birth and the start of 5-minute PIOMI or 15-minute oral stimulation program), sex, and feeding methods before treatment in the three groups. As mentioned previously, age at birth and the beginning of the intervention and feeding method was comparable between the 3 groups (P>0.05). At the same time, the frequency of male infants was significantly lower in the 15-minute oral stimulation program group (P=0.034).

Based on the results of the marginal homogeneity test in Table 3, before the intervention, none of the infant groups were breastfed, whereas this changed to 17.6%, 41.2%, and 5.9% in the 5-minute PIOMI, 15-minute oral stimulation program, and control groups, respectively

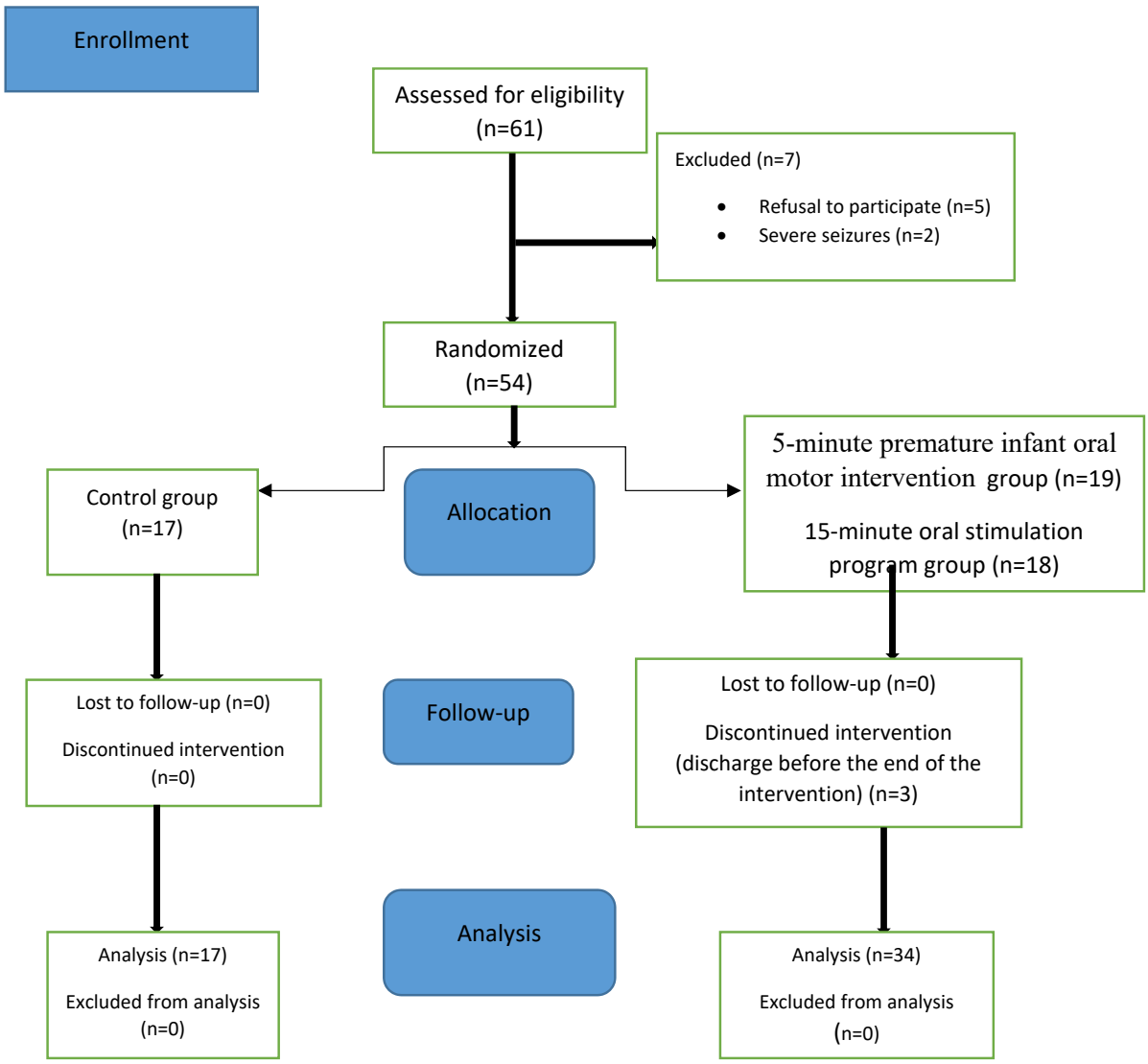

Figure 2. Participants flowchart

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(P<0.05). Table 4 shows that the 15-minute oral stimulation program group had shown significant improvement in feeding compared to the 5-minute PIOMI and control groups (P=0.007). As the sex distribution was different between the 3 groups, we stratified the analysis based on gender as one way of controlling confounding effects. According to the exact P of the chi-square test, there was no significant difference between the three groups in terms of post-intervention feeding methods in females (P=0.290). But for males, breastfeeding frequency was significantly higher in the 15-minute oral stimulation program group (P=0.03) (Table 5).

Discussion

This study was conducted to identify the effects of various treatment methods on term infants and compare the duration of the lactation therapy between PIOMI and the 15-minute oral stimulation program. We found that the 15-minute oral stimulation group had better feeding effects on infants than the 5-minute PIOMI and the control groups. Those receiving longer treatment (15-minute oral stimulation group) had a greater improvement than those receiving shorter treatment (5-miute PIOMI group). However, the control group showed minimal improvement in feeding methods, most likely due to the normal growth and development over the 7 days (Table 3). Due to the age of the participants in this study, the 15-minute therapy period could be performed. The

Table 2. Demographic and baseline characteristics of the participants

Characteristic		Mean±SD/No. (%)			P
		5-minute Premature Infant Oral Motor Intervention	15-minute Oral Stimulation Program	Control	
Age at birth (w)		37.24±0.44	37.41±0.62	37.59±0.79	0.407*
Age at the beginning of the Intervention (w)		38.18±1.07	38.53±1.28	38.29±1.16	0.730*
Gender	Female	6(35.3)	13(76.5)	7(41.2)	0.034**
	Male	11(64.7)	4(23.5)	10(58.8)	
Type of feeding method (beginning of the intervention)	NPO[a]	7(41.2)	7(41.2)	10(58.8)	0.75**
	Syringe feeding	9(52.9)	9(52.9)	7(41.2)	
	Bottle feeding	1(5.9)	1(5.9)	-	
	Breastfeeding	-	-	-	

[a]Nothing by mouth, *Based on the Kruskal-Wallis test, **Based on the chi-square test.

group using the longer 15-minute therapy had a greater positive impact than the PIOMI group, signifying that longer treatment yields better results.

This finding is in line with the study of Osman in 2016, where PIOMI was provided to two groups at 30-32 weeks; one group received 7-day therapy, and the other received a longer treatment period. They found that the additional days of therapy led to a greater impact on their feeding skills [31]. Fucile et al.'s findings showed the positive effects of the 15-minute oral stimulation program on the attainment of full oral feedings in infants [22]. Furthermore, Thakker et al. studied PIOMI on preterm infants with a mean age of 32 weeks, and due to their age, they could offer PIOMI two times per day rather than 1 time. They found considerably improved feeding compared to the control group [32].

According to the findings of Lessen Knoll et al., an early start to therapy with PIOMI on preterm infants at 33 weeks enhanced feeding skills over time compared to the control, who only had negligible improvements due to normal de-

Table 3. Within groups comparison of the type of feeding method

Variables			No. (%)		
			5-minute Premature Infant Oral Motor Intervention	15-minute Oral Stimulation Program	Control
Type of feeding method	Beginning of the intervention	NPO[a]	7(41.2)	7(41.2)	10(58.8)
		Syringe feeding	9(52.9)	9(52.9)	7(41.2)
		Bottle feeding	1(5.9)	1(5.9)	-
		Breastfeeding	-	-	-
	After intervention	NPO	-	-	-
		Syringe feeding	3(17.6)	3(17.6)	11(64.7)
		Bottle feeding	11(64.7)	7(41.2)	5(29.4)
		Breastfeeding	3(17.6)	7(41.2)	1(5.9)
P (marginal homogeneity test)		-	<0.001	<0.001	0.001

[a]Nothing by mouth.

Table 4. Between groups comparisons of type of feeding method

Type of feeding method (after intervention)	No. (%)			Exact P (chi-square test)
	5-minute Premature Infant Oral Motor Intervention	15-minute Oral Stimulation Program	Control	
NPO[a]	-	-	-	0.007
Syringe feeding	3(17.6)	3(17.6)	11(64.7)	
Bottle feeding	11(64.7)	7(41.2)	5(29.4)	
Breastfeeding	3(17.6)	7(41.2)	1(5.9)	

[a] Nothing by mouth.

velopment [33]. Oral feeding is a crucial milestone for appropriate growth and development [34-36]. This finding is consistent with Coker-Bolt et al.'s study, which found that oral motor stimulation was effective in infants. In this study, the treatment group received the oral motor treatment once a day, 6 days a week, and attained full bottle feeding 2 days earlier than infants in the control group [37].

In line with our research, a systematic review study by Tian et al. involved 11 clinical trials and concluded that oral motor intervention might improve feeding skills. Furthermore, they found that intervention decreased duration of hospitalization and family anxiety [38]. Assadollahpour et al. reported that non-nutritional sucking and oral stimulation treatments improved the feeding skills of infants which was in line with the results of the present study [39]. Green et al. distributed a Cochrane review on several oral motor stimulation techniques, including PIOMI, and found that oral stimulation in preterm infants improved infant feeding skills [40].

It is important to note that in the current study, a bias was found due to the sex distribution differences in the participants; the 15-minute oral stimulation program group had significantly more females than males, and the PIOMI group had significantly more males. However, this bias was considered in the statistical analysis. This limitation advocates further studies be undertaken with larger groups of different sexes and ages. The influence of these variables will be essential for future evaluations. We also recommend that more research be done on this topic by comparing other treatment methods for infant

Table 5. Between groups comparisons of type of feeding method according to gender

Gender	Type of feeding Method After Intervention	No. (%)			Exact P (chi-square test)
		5-minute Premature Infant Oral Motor Intervention	15-minute Oral Stimulation Program	Control	
Male	NPO[a]	-	-	-	0.03
	Syringe feeding	2(18.2)	0	8(80.0)	
	Bottle feeding	8(72.7)	3(75.0)	1(10.0)	
	Breastfeeding	1(9.1)	1(25.0)	1(10.0)	
Female	NPO[a]	-	-	-	0.290
	Syringe feeding	1(16.7)	3(23.1)	3(42.9)	
	Bottle feeding	3(50.0)	4(30.8)	4(57.1)	
	Breastfeeding	2(33.3)	6(46.2)	0	

[a]Nothing by mouth.

feeding problems. The validity of oral motor therapy has been shown through its analysis in different environmental settings in several countries worldwide.

Conclusion

The 5-minute PIOMI has been confirmed as an effective early intervention for small preterm infants as young as 29 weeks, and the short 5-minute therapy time is accepted in the preterm infant population. It influences the brain's plasticity and improves neurosensory and motor skill development for feeding. The current study indicates that PIOMI remains effective versus the control group in the full-term population as well, though the longer 15-minute oral stimulation program, while being similar, is more effective in term infants. This finding shows that full-term infants can endure and benefit from longer than 5 minutes exercises per day of oral motor therapy.

Strong points of our study

The strengths of the current study are the validation that the short –and the longer 15-minute treatment protocols effectively increase feeding efficiency in full-term infants and the supporting previous study findings that the longer the therapy would have better outcomes. For the term infants, this would show the benefit of doing a longer therapy period each day. For the preterm population, where only shorter therapy can be tolerated, it would indicate to start treatment sooner and continue it for more days and or more times per day for the greatest effect.

Data availability statement

All data generated or analyzed during this study are included in this article and its supplementary files. Further inquiries can be directed to the corresponding author.

Ethical Considerations

Compliance with ethical guidelines

All participants had given their written consent to participate in the study, and the data collection procedure was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code: IR.MUMS.REC.1399.473).

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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