Effect of an early oral stimulation program on oral feeding in preterm neonates
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Objective
To evaluate the effect of prefeeding oral stimulation program on feeding performance, weight gain, and length of hospital stay of preterm infants in neonatal ICUs.

Background
Previous research has declared that poor oral-motor developments in premature infants are common. So, most of the preterm infants require individualized therapy. Early intervention of oral-motor management on feeding pattern improves the outcome.

Patients and methods
To reach the goal of this research, a case–control study was conducted. A total of 50 preterm infants were divided into two groups: (a) interventional group (25 preterm infants), which received prefeeding oral stimulation program by stimulation of the oral and perioral structures for 5 min for 10 days and was started immediately after delivery, and (b) control group (25 preterm infants), which did not receive stimulation. Postmenstrual age, total intake volume, body weight, the transition time from initiation of oral feeding to full oral feeding, and feeding efficiency were calculated.

Results
We found that the mean oral feeding duration was significantly lower among intervention group compared with control group ($P = 0.04$). The percentage of weight change was significantly higher among intervention group compared with control group ($P = 0.03$).

Conclusion
Our study reveals that early sensory oral-motor stimulation with nonnutritive sucking in preterm infants may be effective to expedite oral feeding and hospital discharge. A touch therapy program may confer a statistically significant weight gain for premature babies at much shorter intervals, which leads to a shorter hospital stay.

Keywords:
early stimulation program, neonates, oral feeding, outcome, preterm

Introduction
Oral feeding is a complex task for preterm infants. Unlike full-term neonates, most infants born prematurely are not able to begin feeding from bottle or breast immediately after birth owing to low muscle tone, immature oral-motor control, and poor coordination of suck, swallow, and breathing [1]. Preterm infants generally need a period of full gavage feeding and then initiate oral feeding between 32 and 35 weeks of age. However, at this age, preterm infants may be unable to take in all prescribed formula orally for each feeding. They usually take days or weeks in the transition period of combined gavage/oral feeding, before reaching full oral feeding [2]. Preterm infants rely on administered feedings and parenteral nutrition to ensure proper nutritional requirements are met. In addition, providing adequate and safe nutrition with underdeveloped cardiovascular, respiratory, gastrointestinal, and central nervous systems is a great challenge for neonatologists [3]. Breastfeeding failure and oral feeding problems in preterm infants often cause long hospital stays, maternal stress, and long-term health problems. Adverse effects, however, are increased owing to the lack of stimuli from the gastrointestinal tract. Safe and successful suckle feeding, via breast or by bottle, is one requirement for hospital discharge and an ultimate goal for preterm infant feeding. Thus, facilitating oral feeding skills and helping preterm infants’ transit to full oral feeding are a key focus for the medical staff of neonatal intensive care units (NICUs) [4]. Recent studies suggest that an oral stimulation program [perioral and intraoral stimulation, with or without nonnutritive sucking (NNS)] applied to preterm infants for at least 10 days in the period of full gavage feeding can facilitate their oral feeding progress. NNS is one of the first coordinated muscular activities in the fetus. Prefeeding oral stimulation is among the most common stimulation techniques in use. These interventions have been proved to be beneficial for oral...
feeding skills, attainment of full oral feeding, weight gaining, and reducing the length of hospital stay [5]. Early oral-motor interventions (OMIs) are beneficial for oral feeding in preterm infants. OMI is defined as sensory stimulation of the lips, jaw, tongue, soft palate, pharynx, larynx, and respiratory muscles, which are thought to influence the physiological underpinnings of the oropharyngeal mechanism, to improve its functions. Previous research has shown that OMI can shorten the transition time from gavage feeding to full oral feeding and improve oral feeding efficiency [6]. The aim of this work to evaluate the effect of prefeeding oral stimulation program on feeding performance and weight gain of preterm infants in NICU and assess the effect of early oral stimulation on length of hospital stays.

**Patients and methods**

After approval of the Local Institutional Ethical Committee of Menoufia University Hospital and after taking a written consent from the guardians of the neonates, this case–control study was performed by selecting 50 preterm neonates delivered in the hospital from NICUs, Menoufia University Hospital, in the period between February 2018 to January 2019. The preterm neonates were divided into two groups: (a) interventional group (25 preterm infants), which received prefeeding oral stimulation program consisting of stimulation of the oral and perioral structures for 5 min for 10 days and was started immediately after delivery, and (b) control group (25 preterm infants) did not receive stimulation. The inclusion criteria were healthy preterm infants less than 37 weeks of gestation, males and females, received all feedings through a tube, stable vital signs, without congenital anomalies or severe complications, and birth weight less than 1.5 kg. Exclusion criteria were full-term infants; congenital anomalies such as chromosomal, genetic, or neurological abnormalities; complex congenital heart disease; congenital gastrointestinal malformations; and infants with medical complications, such as grade III or IV intraventricular hemorrhage, periventricular leukomalacia, or necrotizing enterocolitis, severe birth asphyxia and severe infections. All infants were subjected to full history taking, and clinical data were collected like age, sex, weight (kg), natal history, Apgar score, gestational age assessment according to Ballard score, physical maturity of the Ballard, and maturational assessment of gestational age. Moreover, oral stimulation program was done by 5-min prefeeding oral stimulation program included two forms of oral stimulation: 3 min of manual perioral and intraoral stimulation followed by 2 min of sucking on a pacifier was delivered. The oral feeding progression was measured. The initiation of oral feeding was defined as the first oral feeding. Independent oral feeding was defined as the point at which the nasogastric tube was removed for 48 h and all milk volume per day was taken from a bottle at 120 ml/kg day 1. The transition time was defined as the number of days between the introduction of oral feeding to obtaining autonomous oral feeding. Infant postmenstrual age at the two feeding milestones was recorded. Oral feeding performance/efficiency was defined as the volume of milk consumed relative to the duration of the oral feeding session (ml/min). The volume transfer was defined as the volume consumed as a percentage of the prescribed volume (%). The nurse on duty, who was blind to the group assignments, recorded the duration and volume in every observed oral feeding session. The length of hospital stay was calculated from the recorded date of admission and date of discharge from the hospital.

**Statistical analysis**

Data were collected and entered to the computer using SPSS 18 (statistical package for the social science) (SPSS Inc., Chicago, Illinois, USA), program for statistical analysis. Data were entered as numerical or categorical, as appropriate. Two types of statistics were done: (a) descriptive statistics, in which quantitative data were expressed in mean, SD of the mean, and SE and (b) qualitative data, which were expressed in number (frequency) and percent (%). Analytical statistics were done by using $t$ test and Fisher exact test to measure association between qualitative variables as appropriate. Moreover, Student $t$ test, which is a test of significance, was used for comparison between two groups having quantitative variables. Mann–Whitney test (nonparametric test), which is a test of significance, was used for comparison between two groups not normally distributed having quantitative variables. The level of significance used was 95%, so $P$ value of more than 0.05 was considered statistically nonsignificant, $P$ value of less than 0.05 was considered statistically significant, and $P$ value of less than 0.001 was considered statistically highly significant.

**Results**

A total of 50 preterm infants (30 males and 20 females) were enrolled and divided into two groups: (a) interventional group (25 preterm infants), which had 16 (64%) males and nine (36%) females, and (b) control group (25 preterm infants), which had 14 (56%) males and 11 (44%) females. The mean gestational age of the interventional group was 34.3 ± 0.75 weeks.
Both groups were age and sex matched. The mean head circumference of the interventional group was 33.1 ± 1.4 cm and the mean length was 43.6 ± 1.3 cm, with no statistically significant differences between intervention and control groups \((P > 0.05)\) (Table 1). We observed that all preterm infants in both groups had Apgar score ranging from 8 to 10. There were no statistically significant differences between both groups (Table 2). Days of hospital stay were significantly shorter among intervention group when compared with control group \((P < 0.001)\); the period of parenteral feeding was significantly shorter in intervention group compared with the control group \((P = 0.004)\), and there were significant differences in the mean oral feeding duration between two groups, as it was reduced in intervention when compared with the control group \((P = 0.04)\) (Table 3). The weight of the studied groups was comparable at admission and had no statistically significant differences \((P = 0.07)\) as well as on discharge \((P = 0.13)\). However, the percentage of weight change was higher among the intervention group compared with the control group \((P = 0.03)\) (Table 4). After receiving prefeeding oral stimulation, the transition time was reduced significantly in the intervention group \((P < 0.001)\) (Table 5).

### Discussion

Oral feeding problems in preterm infants (breast or bottle-feeding failures) often result in delayed hospital discharge, maternal stress, and long-term health problems [7]. Most premature infants are not able to begin feeding from bottle or breastfeed immediately after birth owing to low muscle tone, immature oral-motor control, and poor coordination of suck, swallow, and breathing. They generally need a period of full gavage feeding and then initiate oral feeding between 32 and 35 weeks of age [8]. The transition to oral feeding from gavage (tube) feeding can be a challenge for preterm infants, as it requires ability to coordinate the muscles of the jaw, lips, tongue, palate and pharynx, upper trunk, and respiratory systems to provide a safe swallow [9]. Early OMIs are defined as sensory stimulation of the lips, jaw, tongue, soft palate, pharynx, larynx, and respiratory muscles, which are thought to influence the physiological underpinnings of the oropharyngeal mechanism to improve its functions. OMI can shorten the transition time from gavage feeding to full oral feeding and improve oral feeding efficiency [10]. Our study showed that interventional group had 64% male patients, whereas female patients were 36%. Both groups were sex and age matched. The mean age of the interventional group was 34.3 ± 0.75 weeks. The mean head circumference of the interventional group was 33.1 ± 1.4 cm and the mean length was 43.6 ± 1.3 cm, with no statistically significant differences between intervention and control groups \((P > 0.05)\). We observed that all preterm infants in both groups had Apgar score ranged from 8 to 10, with no statistically significant differences between both groups. Fucile and Gisel [11], were in agreement with our results and reported that the mean Apgar score at 1 min after labor in the intervention group was 7.78 ± 2.32 and in the control group was 7.38 ± 2.42, with no statistically significant differences between both groups \((P = 0.496)\). The mean Apgar score at 5 min after labor in the intervention group was 8.55 ± 1.93 and in the control group 8.45 ± 1.97,
weight change was higher among the intervention group compared with the control group (P = 0.03). Similar observation was noticed by Bache et al. [16] who found that mean weight (kg) at admission of the intervention group was 1597.38 ± 264.263 compared with control group (1652.50 ± 327.468), with no statistically significantly differences (P = 0.329). On discharge, the mean weight was 806.56 ± 115.24 in intervention and 2178.39 ± 210.02 in the control group, with no statistically significant differences (P = 0.728), whereas the percentage of weight change was significantly higher among intervention group (11.93 ± 3.86) compared with control group (9.2 ± 5.2), with P value of 0.040. On the contrary, Arvedson et al. [17], reported that the percentage of weight change was significantly lower among intervention group (mean weight, 1836.09 ± 193.04) when compared with the control group (2002.90 ± 203.41) (P = 0.001). This could be explained by differences in number and inclusion criteria of the studied neonates. After receiving prefeeding oral stimulation, the transition time was reduced significantly in the intervention group (P < 0.001). In accordance with us, Karagol et al. [18], reported that the time from first successful oral feeding until full oral feeding was statistically significantly lower for experimental group, with mean transition time of 3.7 ± 3.5 days, when compared to control group (9.3 ± 7.7 days) (P < 0.05).

Conclusion
The results obtained in our study support the association of early sensory oral–motor stimulation with NNS in preterm infants and hospital discharge. A touch therapy program may confer a statistically significant weight gain for premature babies at much shorter intervals, which leads to a shorter hospital stay. Further studies are required to establish this finding.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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