American Journal of Sciences and Engineering Research

E-ISSN -2348 – 703X, Volume 6, Issue 1, 2023

Early Oral Motor Intervention for the Development of Sucking and Feeding Skills of Preterm Infants

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Abstract:

Purpose: *The aim of this current study is to explore whether non-nutritive sucking skills in isolation would increase effective feeding skills in preterm. And to find out the effectiveness of an oral motor intervention and nonnutritive sucking collectively in the development of sucking and feeding skills of premature children.*

Method: *After reading abstracts, the English Language databases were searched from PubMed, google scholar and research4life. the relevant data search was collected over 22 years from 2010 to 2022.*

Discussion: *The number of studies provided OMI to preterm infants but very few studies focused on non-nutritive sucking as an intervention approach. OMI has a great impact on sucking, length of hospital stay and alteration of oral feeding.*

Conclusion: *Early oral motor and sensory intervention can improve sucking and feeding skills in preterm infants. And it also helps in the alteration of tube feeding to oral feeding, milk intake, early discharge, and a short stay in hospitals*

I. Introduction

Feeding skills are important for the growth and development of infants regardless of term or preterm (Arora, K., et, al.,2018) · Prevalance of premature birth is 15 million globally every year and the survival rates of premature infants has increased because of advanced medical technologies (Shokri, E., 2022) and (Li, L., Liu, L.,2022).

The children born before the 37th week and have weight >1500g are referred to as preterm (Arora, K., et, al., 2018). Preterm infants are at risk for neurological problems because of prenatal and perinatal strokes due to which they develop difficulties in many areas including motor, sensory, language, speech, Feeding, and cognition (Slattery, J., Morgan, A., & douglas, J., 2012) and (Arvedson, J., et, al.., 2010).

Oral feeding requires high sensorimotor integration, infants born at less than 32 weeks, are incapable to feed orally and need gavage feed because of their immature oral motor structures, functions, and uncoordinated suck swallow breath pattern. Which usually develops in 32-34 weeks of gestational age.(Fucile, S., Milutinov, M., Timmons, K., & Dow, K. (2018) and (Aguilar-Vázquez, E. et, al., 2018).

The pattern of suck swallow and breath ensure that the food safely propels down from mouth to stomach (Aguilar-Vázquez, E. et, al.,2018) and (Tian, X ¨ et, al., 2015). Nonnutritive sucking (NNS) is a suction of stimuli other than Food it improves the efficiency of the oral feeding. NNS stimulates the oral cavity and increases vagal activity. Efficient nutritive sucking is an important skill for safe feeding, but it is a challenging milestone for the preterm. The alteration from tube to oral feeding takes time, which causes a delay in feeding skill development in the first year of life, regards to sucking and eating semisolids and solid foods (J Pediatr. 2015) and Arvedson, J., et, al.., 2010).

Literature review

 Received-18-01-2023, Accepted- 26-01-2023

Neurodevelopmental status is an important in the shifting from tube to oral feeding which depends upon many factors including behavior organization, efficient sucking, coordinated suck swallow breath pattern which need to occur sequentially from oral to pharyngeal to an esophageal phase of the swallow, with no negative pulmonary pressure and cardiorespiratory regulation (J. Pediatr. 2015) and (Medoff-Cooper, B., 2015).

The swallowing process has three phases' oral, pharyngeal and esophagus phases and breathing coordination is important between them. Inappropriate and inadequate nutrition has a great impact on brain development. According to the WHO statement, human milk at first 6 months is crucial for the infant's development, studies suggest that human milk intake directly expressed from mothers reduce the chances of life-threatening conditions for premature infants (Vargas, C. L., et, al., 2015) and (Tian, X., et, al., 2015).

The Studies used NNS and pre-breastfeeding, oral motor intervention program and feeding positionas an interventional method to improve feeding in premature infants (Guler, S., et al., 2022) and (Shokri, E.,et al., 2022). In a study music therapy also used as a mode of intervention affecting feeding skills of premature newborns with neuro-developmental issues.(Shokri, E., 2022). All searched studies developed the criteria of enrollment: low birth weight less than1500g and 32 weeks or less gestational age.

In a study, the infants who showed weak performance on oral motor movements and poor or inefficient sucking strength and power are divided into 2 groups. A case group was facilitated by strengthening exercises intervention for five consecutive sucking movements and physical therapy and the other group had non-nutritive sucking ability so they provided only physical therapy, according to sucking and feeding abilities. It revealed that the performance of the study group was better than control and the oral stimulation program improve the sucking component, which helps in better oral feeding (Yan-Lin Lou et, al., 2010).

As compared with normal full-term infants, the preterm infants sucking was either dysfunctional or disorganized and they do not show developed sucking movement when suckling was present. Despite differences, both groups developed sucking at an average age of 1.5-3 months of age. Munching seen in premature infants before full term, the median age of development is 1.5-3 months in preterm children and 5 months in full-term (J Pediatr. 2015).

A study mentioned that when more than one pattern of suction observed in infants it considered the transition toward a more mature sucking pattern Improved Apnea during multiple swallows without breathing usually related to maturation with age rather than with training and practice (the period of sucking burst was a minimum of 1 sec) (Edda Aguilar-Vazquez., 2018).

The infant presented with one of the following non-nutritive sucking patterns. **Type 1** inhale swallow rest, **Type 2** inhale swallow inhale or exhale swallow exhale, **Type 3** when there is a pause between two or more swallow. It is evident that the suck, swallow and breathe alterations improved through adequate head position concerning Strunk and alignment of an infant during feeding (Aguilar-Vázquez, E., 2018).

Another reseach stated that if the child is unable to sustain sucking for 2 minutes at 46 weeks PMA due to muscle weakness and endurance, and had no mature sucking at 40 weeks, it increased the chances of abnormal brain development at 2 years of age (Mechteld et.al (2014) and (Arora, K., 2018).

A study looked into how music therapy affected premature newborns. Music has become a therapeutic intervention for newborns at risk for neuro-developmental issues, particularly premature infants, due to the widespread effects of music on brain function, including auditory perception, language processing, attention, memory, emotion, mood, and motor abilities. The modulation of senses, weight gain, and eating are all impacted by music therapy, which also lowers baby stress and hospitalisation. A series of bilaterally and unilaterally triggered cognitive, motor, and affective reactions are elicited by music (Shokri, E., 2022)..

A single-blind, parallel randomised clinical trial was carried out From September 2021 to February 2022 in Iran. The study included premature infants with post-menstrual ages of 26 to 30 weeks. 52 infants were split into the intervention and control groups at random. PIOMI was given to all the infants, and music therapy was added for the intervention group. Weight growth, feeding progression, Preterm Oral Feeding Readiness Scale (POFRAS), milk volume, and length of hospitalisation were all compared between the two groups' members. As a result, the intervention group achieved independent oral feeding quicker, had a shorter hospital stay, and had a higher POFRAS score. No differences on weighgain was reported (Shokri, E., 2022).

Another, single-blind randomised trial study conducted between May 2019 and March 2020 to assess the effects of the Premature Infant Oral Motor Intervention (PIOMI) on the growth of oral-motor function, feeding,

and anthropometric outcomes using sucking manometry. A sample of 60 preterm newborns from two neonatal critical care units were taken. The experimental group was provided initially 6 steps of intervention started from cheeks to the lips then moving internal oral cavity to stimulate gums , palate , and tongue after that PIOMI for 5 minutes per day For 14 consecutive days provided bilindly. And sham intervention without oral motor therapy was given to the control group. Measurements were made on sucking ability (sucking time, amount and power), anthropometrics (weight and head circumference), bottle feeding, initiating breast or chest feeding, and length of hospital stay. For this investigation, the Yakut Sucking Manometer was created especially aand uswd for the test. The results indicates that , the experimental group outperformed controls in terms of sucking power (69%), continuous sucking before releasing the bottle (16%), sucking time (13%), and sucking volume (12%). In comparison to the control group, the experimental group experienced greater increases in weight (89%) and head circumference (81%). The experimental group started breast/chest feeding 10.8 days sooner than controls, transitioned to oral feeding 9.9 days earlier than controls, and was discharged 3.0 days earlier. Anthropometrics, sucking ability, willingness to begin bottle and breast/chest feeding, and a 3-day decrease in hospital stay were all significantly improved by the PIOMI (Guler, S., et, al., 2022).

A case-control investigation was carried out to assess how preterm newborns in neonatal ICUs respond to feeding, how much weight they gain, and how long they stay in the hospital. A total 50 preterm babies were divided into two groups: (a) the interventional group, which received a 5-min prefeeding oral stimulation regimen was used, and it contained two types of oral stimulation: 3 minutes of manual perioral and intraoral stimulation and 2 minutes of pacifier sucking. The development of oral feeding was gauged for ten days starting immediately after delivery, and (b) the control group, which did not receive any stimulation. The transition period from oral feeding to full oral feeding, body weight, postmenstrual age, total intake volume, and feeding efficiency were all calculated. The results indicated that, the mean oral feeding length was considerably shorter ($P = 0.04$) and percentage of weight change was larger ($P = 0.03$). in the intervention group when compared to the control group (El Mashad., et, al., 2021).

Discussion

Swallowing is an involuntary act and reflexive process during feeding. To develop this skill properly, it is essential to combine a great variety of structures including bone, oral and pharyngeal muscles and cranial nerves (Aguilar-Vázquez, E. et al., 2018) and (Medoff-Cooper, B, et al., 2015). This in combination helps in movement and sensation during swallowing. Lingual Strength and motion are key organs for efficient breastfeeding because when it functions within normal limits, it will help in the development of suckling then volitional sucking followed by eating semisolids then solids. Structural changes, brain maturation, sensation and sensory feedback (taste, touch, pressure proprioceptive, temperature) are important factors for the swallowing skills development ((Medoff-Cooper, B, et al., 2015) and (Törölä, H., et al., 2012).

Sucking skills improve with gestational age in preterm infants. At six months of age, the child sucks food whether it is liquid or semisolid but when it became messy and time-consuming it indicates feeding problems (Fucile, S., et, al.,2018) and (Liu, Y.-L., et,al 2013)

The effectiveness of feeding skills in preterm newborn not only depend upon the gestational age of the children but also depend upon the alertness, physical stability, self-regulation, muscle tone, energy reserve, hyper sensation to the stimuli and the development and maturation of the neurological system. Long stay in hospitals due to suctioning, tube feeding even on intubation has an aversive impact on the oral motor and sensory functions and it causes oral feeding problems in infants. It increases the financial burden and develops psychological distress in parents (Tian, X., et, al., 2015) and (Törölä, H. et, al., 2013).

In recent years because of assisted technologies, survival rates of premature babies have increased (Törölä, H. et, al., 2013). Inefficient feeding cause fatigue and weight loss and swallowing on inhalation are common to these infants, which causes aspiration. Infant's safety is an important consideration for the transformation from gavage to oral feed. Moreover, transactions from liquid to different consistencies and textures are also difficult for the infant to manage at later months(Törölä, H. et, al., 2013). GA or low birth weight is not the only indicator of the performance of oral feeding, it also indicates the performance of oral motor skills; feeding practice, behavior, and technique which contributes to feeding performance. The premature infant has other medical conditions also, regardless of neurological immaturity such as respiratory, heart or gastrointestinal problems with affecting the SSB pattern (Törölä, H. et, al., 2013). .

In infants, sucking played a major role in the development of feeding skills and it generated a negative pressure in the oral cavity. NNS used as a method of intervention in the nurseries and NICU (Liu, Y.-L., et, al., 2013). Facilitation of feeding skills and development of feeding skills is the primary key feature in intensive care unit (Arvedson, J., et,al., 2010).. Early motor assessment can provide a sense of central nervous system functions and need to facilitate early intervention. Using a pacifier can help in the development of more organized and appropriate behavior for optimal feeding and reduce stress, gives a calming effect, better growth and allow better and faster transition from the probe to oral feed (Aguilar-Vázquez, E., et, al., 2018).

Suction comes in the prenatal period and starts to develop at 29 weeks of GA, in 32_34 weeks of GA SSB pattern develops in a coordinated manner. In premature infants, sucking patterns usually disorganized. There is a number of studies published, which used early oral motor intervention for the effectiveness of feeding skills and developmental outcomes for premature babies. They achieve oral intake up to 45ml per meal and shortened the hospital stay(Guler, S., et, al., 2022)

Premature born with a more regulated suck pattern developed individualized oral feeding three days before the infants with a pattern of unregulated sucking burst. Modification of feeding behavior, structure, and positioning with oral motor intervention gives good results in swallowing in the preterm. A research supported the hypothesis that oral sensorimotor intervention can affect the alteration from tube to oral feeding and improved breastfeeding in premature infants at the hospital discharge (Fucile, S.et,al., 2018). Those receive intervention achieved full oral intake earlier than those who did not receive it. They did not find the difference in oral motor skills between both groups as they anticipated that there would be a difference. Low Breastfeeding rates in premature infants are not because the mother does not want to breastfeed it may be due to less maternal support(Fucile, S.et,al., 2018) and(Törölä, H., et al., 2012).

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Many studies used neonatal oral motor assessment scale (NOMAS) which is a non-invasive and quantitative scale that used as a tool to assess infants sucking skills whether it is disorganized, dysfunctional or normal (Törölä, H. et, al., 2013). Oral motor assessment should be descriptive and qualitative rather than qualitative because preterm infants have qualitative feeding issues (Fucile, S.et,al., 2018) and (Arora, K. et, al., 2018).

A randomized controlled study was done in which they took premature infants with no other medical conditions and they are randomly assigned in a group. Interventional group received oral motor intervention for 5 mins, thrice in a day for three consecutive days by using premature infant Oro-motor intervention (PIOMI), if focus on assisted movement of muscles contraction and resistance to develop strength and control group received sham intervention, it is an unstructured intervention which includes stroking around the lips and oral cavity. Improvement was seen in the NOMAS score after 7 days of intervention for those who received PIOMI as compared to the control group. The intervention significantly improves the oral motor skills, reducing the transition time from tube to oral feed, weight gain and shortened the hospital stay (Arora, K. et, al., 2018).

A meta-analysis was published with 63 citations that include 855 participants. They said that oral motor intervention improved the transient time, oral intake of milk, shorten the length of the hospital and increase the efficiency of oral feeding (Xu Tian et.al., 2015).

A systematic review was conducted on the outcomes of oral-motor intervention in the physiology of feeding, swallowing and respiratory health of preterm infants. Twelve studies are taken for the systematic review in which the intervention focused on NNS, oral and peri-oral stimulation (stroking on the arm, shoulder neck legs, and head) and OMI with oral stimulation. A feeding skill or sucking pressure was found in six research that were incorporated into how OMI affected the eating and swallowing physiology. Ten research that focused on the beneficial effects of oral feeding on weight growth and development as well as respiratory health provided information. (J. Arvedson et al., 2010)

In studies, Instrumental analysis for pharyngeal swallow did not use. However, the research team decided to identify oral feeding and swallowing intervention effectiveness by using three different methods. They found out the mixed result of physiological feeding and swallowing outcomes such as the amount of oral intake, changes in weight /average weight gain, days and number of tube feeding and the alteration from tube to oral feeding is challenging for both children and caregivers. One study showed a significant effect on weight gain but other studies did not show significant changes in weight and in length and head circumference. They found

out the mixed result of oral and peri-oral stimulation, there is less research evidence presented to support or refute this intervention in the clinical practice(Arvedson, J., et,al., 2010.

However other study has reported the outcomes of their research that confirm the link between early sensory-oral-motor stimulation and NNS in preterm infants as well as hospital discharge. For premature babies, a touch treatment programme may result in statistically meaningful weight gains at far shorter intervals and shortening their stay in the hospital l (El Mashad., et, al., 2021). Another study reported the effects of music on brain function, including auditory perception, language processing, attention, memory, emotion, mood, and motor abilities. It used PIOMI and music therapy as an interventional approach that resulted in the modulation of senses, weight gain, and eating are all impacted by music therapy, which also lowers baby stress and hospitalisation by 6 days and enhance the eating progression of preterm newborns by 8 days (Shokri, E., 2022)..

A prospective observational study was performed in which they found out significant differences in GA at birth and hospital discharge and birth weight. No significant differences indicated in the mean suck amplitude but indicated significant differences between mean suck frequency, duration, and smoothness between full-term and preterm infants. There was the variability of performance during sucking between the groups. Less variability seen in amplitude and frequency in preterm and the full term had less variability in the smoothness of sucking(Gilson et.al., 2019).

A study examined the sucking organization after multi-sensory intervention in preterm infants. Multi senses addressed biological immaturity and increased the social environment to help in the behavioral organization of feeding skills As feeding skills have improved, the sucking and swallowing frequency, bolus volume, size, and amplitude also increased. In addition, birth weight can be serving as an indicator of feeding strength (Medoff-Cooper, B. et al., 2015).

However, at 3 to 6 months of age breastfeeding rates reduced after hospital discharge. For some mothers, inadequate milk production is an issue in the transformation of breastfeeding to bottle feed. Maternal support found to be a great factor that reflects in breastfeeding achievement. Lip closure during suckling indicates lip strength and helps to prevent spillage during milk feeding and avoid fatigue during the feeding process. Infants who have low muscle tone provide mandibular support, which helps in lip closure during the sucking and feeding process. Cheek support is essential for intraoral pressure; it provided by exerting a little pressure on the corner of the lips and helped in tongue movement. For hypertonic infants both support techniques needed. Some children performed fast speed of sucking burst which causes fatigue, choking and respiratory distress. Medoff-Cooper, B. et al., 2015

Disorganized or even dysfunctional sucking patterns did not predict the later delay on feeding skills but contributed to the long-term barrier for the child to achieved breastfeeding skills (Törölä, H., et al., 2012.

A study compared two methods of sucking intervention by using mother's finger and pacifier with Breastfeeding behavior scale. They took 150 children and divided in three groups A was given NNS by mother's finger (MF) group B pacifier (NNSP) and group C no inervention. The result showed significant differnces in rooting, sucking, hospital stay and initiation of oral feeding independently. NNSMF had initiated oral feeding early followed by shorter hospital stay and then NNSP, controls scored low score in the scale (Shaki, F., et al., 2022). one more study's findings demonstrated that non-nutritive finger sucking by mothers can improve preterm infants' food tolerance and fasten the development of independent oral feeding, leading to an earlier discharge from the hospital Pirkashani, L.M., et al., 2018).

Howverever, other study used preterm oral feeding readiness Assessment scale and assessd infants pre and post sensorimotor intervrntion. Case group had given tactile/ kinesthetic stimulation and NNSP and the controls received only NNSP intervention. The intervention had a better level of feeding success. Although the intervention group's transition to full breastfeeding and time from hospital discharge were quicker, it was not statistically significant.(Çamur, Z. and Çetinkaya, B., 2022)

Most of the studies supported that those preterm infants had severe feeding issues were those who had to prolong breathing support during the hospital stay. A comparison between preterm and full-term sucking ability should be assessed before hospital discharge in order to screen the infant's feeding skills. (Arora, K. et, al., 2018).

Interaction between mother and premature children is at risk because of the feeding problem. Breastfeeding mothers directly show their love by touching, giving a tactile stimulus and look at them during and after feeding and exchange a social smile and eye contact with each other. This is not possible for the

preterm infants who are on gavage feed, the limitation of some studies is that they did not assess qualitative feeding skill (Arora, K. et, al., 2018).

Almost all the studies supported that uncoordinated SSB results in a longer hospital stay and feeding issues. Some published studies revealed the efficacy of oral stimulation, support and non-nutritive sucking collectively helps in the enhancement of feeding skills and shortens the hospital stay for preterm infants(El Mashad., et, al., 2021); (Shokri, E., 2022).. . Some studies examined that multimodality sensory stimulation has a great effect on sucking and swallowing performance. However, studies did not support that OMI increases weight in neonatal children. There are many studies published which proved that OMI has a great effect on the development of feeding skills (Medoff-Cooper, B. et al., 2015). The control trial studies used NNS and oral stimulation together with the sham intervention. Oral motor assessment is done only once during the initial week of admission, if it was repeated throughout the hospital course, it would have detected the differences (Fucile, S.et,al., 2018)

Very few studies used non-nutritive sucking and Oral motor stimulation as a collective treatment approach for preterm infants. Gestational age is not an important determiner of good oral motor skills. Most of the studies have excluded preterm infants with feeding problems who have other medical conditions. The variables of such infants cannot be controlled, the type and severity, etc. control of external variables is difficult in the intervention process of feeding such as the rate of nipple flow, position and alignment of the infants during feeding. Aside from quantitative and systematic intervention, qualitative assessment should also be done during an intervention procedure.

The frequency of nutritive sucking determines the maturation of nutritive sucking behavior. The type of nipple helps in sucking. Nipples with a slower rate of milk flow reduce the interruption of respiration during swallow and carry out manageable bolus size that is easy to control by preterm infants. Those nipples that flow a large amount of milk interrupt in respiration and increases the chances of apnea and bradycardia as the bolus size is large and unmanageable by preterm infants. Oral motor intervention should be standardized, qualitative and systematic and rationalized to intervene infants and follow a standard clinical protocol. Evaluation of nutritive sucking and feeding skills is essential in NICU to screen infants whether pre or full term in order to reduce the chances of readmission in the hospital or long stay in hospital. And also it is important to identify the feeding issues in infants with good oral motor skills because other medical condition which causes fatigue during feeding. Reevaluation of preterm infants after first assessment should be timely schedule during and end of the study as some of the studies did the first assessment and 2nd assessment was done end of the study, which might give false-negative results.

II. Conclusion

In conclusion, early oral motor and sensory intervention can improve sucking and feeding skills in preterm infants. And it also helps in the alteration of tube feeding to oral feeding, milk intake, early discharge, and a short stay in hospitals. But there is less evidence in the weight gain of children by oral motor intervention and later neurological growth and development in premature infants. Aside from abnormal neurodevelopment, preterm infants have other conditions such as respiratory issues, cardiac and gestational problems which influence on suck swallow breath pattern and increase the chances of feeding problems.

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