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# Oral motor disorder and feeding difficulty during the introduction of complementary feeding in preterm infants

## *Disfunção motora oral e dificuldade alimentar durante a alimentação complementar em crianças nascidas pré-termo*

### Keywords

Feeding and Eating Disorders  
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### Descritores

Comportamento Alimentar  
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### ABSTRACT

**Purpose:** To investigate the association between oral-motor disorder and feeding difficulty during the process of introducing complementary feeding in preterm infants. **Methods:** This is a cross-sectional, observational, and quantitative study. Preterm infants who had already begun complementary feeding and were up to 24 months corrected gestational age, were followed up at an outpatient clinic for high-risk newborns. The feeding difficulty was assessed using the mother's perception of the presence of defensive behaviors in their child. The measurement of the oral motor skills performance was obtained through the application of an adaptation of the Clinical evaluation protocol of pediatric dysphagia (PAD-PED). **Results:** The sample consisted of 62 dyads of children with a mean corrected gestational age (CGA) of 13.5 months. Complementary feeding was introduced at the sixth month CGA by almost half of the mothers and most of them reported some sort of difficulty with this activity. Extreme prematurity revealed an association with defensive feeding behavior ( $p = 0.005$ ), as well as with the initial introduction of food with liquid consistency ( $p = 0.001$ ), the extended period of time using enteral tube feeding ( $p = 0.044$ ), the continuous positive airway pressure (CPAP) ( $p = 0.013$ ) and parenteral nutrition ( $p = 0.039$ ). **Conclusion:** There was no significant association between oral motor disorder and feeding difficulty.

### RESUMO

**Objetivo:** Investigar a associação entre a disfunção motora oral e a dificuldade alimentar durante o processo de introdução de alimentação complementar em crianças nascidas pré-termo. **Método:** Trata-se de um estudo transversal, observacional e quantitativo. Nele, foram incluídos prematuros em acompanhamento em um ambulatório de seguimento de recém-nascidos de alto risco, que já tinham iniciado a alimentação complementar e possuíam até 24 meses de idade gestacional corrigida. A dificuldade alimentar foi investigada mediante a percepção da mãe quanto à presença de comportamentos defensivos do filho. A medida do desempenho das habilidades motoras orais foi obtida a partir da aplicação de uma adaptação do Protocolo de Avaliação Clínica da Disfagia Pediátrica (PAD-PED). **Resultados:** A amostra foi composta por 62 díades de crianças com média de 13,5 meses de idade gestacional corrigida (IGC). A alimentação complementar foi introduzida no sexto mês de IGC por quase metade das mães, e a maioria delas informou algum tipo de dificuldade nessa introdução. A prematuridade extrema revelou associação com o comportamento alimentar defensivo ( $p=0,005$ ), assim como a introdução inicial de alimentos na consistência liquidificada ( $p=0,001$ ), o tempo prolongado de uso de sonda enteral ( $p=0,044$ ), a pressão positiva em vias aéreas (CPAP) ( $p=0,013$ ) e a nutrição parenteral ( $p=0,039$ ). **Conclusão:** Não foi encontrada uma associação significativa entre a disfunção motora oral e a dificuldade alimentar.

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## INTRODUCTION

Biotechnological and scientific advances have reduced the mortality of children born preterm, on the other hand, increased morbidities related to growth deficit and neurodevelopment<sup>(1)</sup>. Such problems can manifest early, persist and reveal themselves through significant delays or without functional impacts<sup>(2)</sup>.

Exclusive breastfeeding should take place until the age of six months, when the introduction of complementary feeding should begin<sup>(1)</sup>, which includes the period in which any nutritious food (solid or liquid) is offered to the child in addition to breast milk or infant formula. Despite the lack of evidence on the best time to start it in preterm children, it is recommended that it be done from six months of corrected age<sup>(3)</sup>.

In the second semester of life, anatomofunctional and behavioral changes enable the acquisition of new oral skills, such as the ability to organize and coordinate the functions of the oral mechanism to consume new foods<sup>(4,5)</sup>. However, oral motor dysfunctions - considered to be functional changes in the oral pattern for feeding - can occur in children born prematurely during the process of introducing complementary feeding<sup>(6-15)</sup>.

Feeding problems in preterm children may be related to their immaturity, neurological deficits, and (or) neonatal period morbidities<sup>(16)</sup>. Four domains underlie feeding difficulties in childhood – medical, nutritional, feeding skills, and psychosocial aspects –, and the damage in one of them can lead to dysfunction in any other<sup>(17)</sup>. The most common feeding difficulties reported by families to health professionals are food refusal, disruptive meal behavior, rigid food preferences, inability to self-feed, among others<sup>(9)</sup>.

Given the above, the objective of this study was to investigate whether there is an association between oral motor dysfunction and feeding difficulties during the process of introducing complementary feeding in children born preterm.

## METHOD

This is a transversal, observational and quantitative study, approved by the Research Ethics Committee under protocol n° 1.376.761.

The sample consisted of dyads of children born preterm, and their mothers or substitutes. The children were born in two public maternity hospitals that are part of the Baby-Friendly Hospital Initiative and were being followed up at the referred outpatient follow-up clinics for high-risk newborns, during routine appointments, from March 2016 to June 2017.

The sample calculation was performed based on a pilot study with 10 dyads, in which we found food difficulties in 50% of those exposed, that is, with oral motor dysfunction, in the ability to use a spoon, a finding on which the study was calculated. Subsequently, the sample was expanded to 62, with a 95% confidence level and 80% power in the effectiveness of the results.

The included children were up to 24 months of corrected gestational age (CGA) and had already started complementary feeding. We excluded those with a medical diagnosis of neuropathies, syndromes, craniofacial malformations, heart

disease, and severe respiratory diseases that prevented them from eating safely orally and also those who presented metabolic diseases.

## Data collection

We contacted the legal guardians for the children to explain the objectives of the research and invited them to participate in the study; once the invitation was accepted, they signed the Informed Consent Form. The authors then applied a protocol developed by them, which included information related to identification; demographic and socioeconomic data; breastfeeding; oral habits; introduction of complementary food and dietary difficulties; the performance of oral motor skills for feeding, and data on neonatal histories, such as gestational age at birth, birth weight, percentile curve, use of mechanical ventilation and positive airway pressure (CPAP) and feeding routes used. After this stage, the main researcher evaluated the child, blind to previous information. The clinical history data that could not be collected in the interview with the mothers or their substitutes were accessed in medical records.

We investigated the difficulty in the food introduction process through the mother's perception of the children's defensive behaviors, during the last month, during meals. Initially, the interviewer asked an objective question about the difficulty in introducing complementary food; later, a checklist based on the proposal of the Brazilian Society of Pediatrics<sup>(16)</sup> was applied to evaluate events that determine the difficulty in the feeding process during the child's meals. The checklist had nine questions with dichotomous answers: Crying at the sight of food? Body arching at the time of offer? Refuse to open mouth? Constant gagging reflex? Increased demand for meals and snacks time (+ 40 min)? Selectivity by type of food and/or texture? Refuses solid? Refuses to feed? Difficulty by the child in obtaining food, chewing, or swallowing? An affirmative answer to any of the items on the checklist was considered as an indication of feeding difficulties presented by the child.

The performance of oral motor skills (OMS) was obtained from the application of an adaptation of the Clinical Assessment Protocol for Pediatric Dysphagia (PAD-PED)<sup>(18)</sup>. First, the mother was asked, if possible, to breastfeed the child who was still breastfeeding; then, that she offers foods of different consistencies and using different utensils, depending on the age group. The mother offered the food with the child positioned on her lap. For children up to eight months of CGA, liquid (water) was offered in a standardized cup (disposable plastic cup - 50 ml), or a transition cup, in the case of children who did not yet use the conventional cup; and heterogeneous pasty food (mashed banana), offered with a standardized plastic spoon. For children from nine to 24 months of CGA, solid food (banana pieces) was added.

The researched OMS variables were as follows: oral sucking skill (OSS), tested both in the mother's breast and in a bottle, and the performance of sealing, grip, and coordination; skill to drink from a glass (SDG), observing apprehension, presence or absence of escape and uptake; skill to remove food from the spoon (SRFS), specifically capture, presence or absence of

**Table 1.** Neonatal clinical characteristics of 62 children born preterm, Salvador (BA), 2018.

Variables	Lost data	N	%
<b>GA at evaluation</b>			
Up to 08 months GA	-	13	21.0
09 to 11 months GA	-	18	29.0
12 to 17 months GA	-	13	21.0
18 to 24 months GA	-	18	29.0
<b>GA at birth</b>			
Extreme premature	-	10	16.1
Very premature	-	35	56.5
Moderate premature	-	17	27.4
<b>Birth weight</b>			
Extreme low weight	-	12	19.4
Very low weight	-	32	51.6
Low weight	-	18	29.0
<b>Percentile curve</b>			
SGA	-	10	16.1
AGA	-	51	82.3
BGA	-	01	1.6
<b>CPAP time</b>			
Up to 7 days	11	37	72.5
08 to 28 days	11	12	23.5
29 to 40 days	11	01	2.0
>50 days	11	01	2.0
<b>Catheter time</b>			
Up to 7 days	11	02	3.9
08 to 28 days	11	23	29.4
29 to 40 days	11	15	29.4
>50 days	11	11	21.6
<b>MV time</b>			
Up to 7 days	24	14	58.3
08 to 28 days	24	6	25.0
29 to 40 days	24	4	16.7
>50 days	24	4	16.7
<b>PN time</b>			
Up to 7 days	37	10	27.0
08 to 28 days	37	23	62.2
29 to 40 days	37	04	10.8
>50 days	-	-	-

**Captions:** GA=gestational age; CGA=corrected gestational age; SGA= small for gestational age; AGA=adequate for gestational age; BGA=big for gestational age; MV=mechanical ventilation; CPAP=positive airway pressure; PN=parenteral nutrition.

escape; tongue movement; and chewing skill (CS), including grasping, presence or absence of escape and masticatory pattern. The evaluation was carried out based on the description of child development for food, carried out by Morris, Klein (2000)<sup>(4)</sup>, the corrected gestational age of the sample was considered for the analysis of responses.

### Data processing and analysis

The database was created using Microsoft® Excel 2010 and analyzed with R (version 3.4.1). We performed a descriptive analysis (mean, standard deviation, absolute, and relative frequency). We used the Chi-Square test or Fisher's Exact test to verify the existence of an association between categorical variables. The level of significance established for this work was 5%.

## RESULTS

The sample consisted of 62 dyads, in which 58.1% (36) of the children were female, and, at the time of the evaluation, the mean age was 13.5 months of corrected gestational age (CGA). Table 1 shows the distribution of the neonatal clinical characteristics of the sample and the ages at the time of assessment.

Regarding demographic characteristics, the results showed that 43.5% of mothers (27) were in the age group of 30 to 39 years old; 82.3% of parents (51) claimed to be married or have a partner; 62.9% of the heads of family (39) completed, at least, high school. From a socio-economic point of view, 53.2% (33) were classified as social class C, according to ABEP\*,

\* ABEP: Associação de Empresas de Pesquisa. <http://www.abep.org/criterio-brasil/> / Accessed on 12 mar. 2015.

and 74.1% (43) reported the family wage income of up to two minimum wages.

Complementary feeding (CF) was introduced before six months by 27.9% (17) of mothers or their substitutes; in the sixth month, by 55.7% (34); and after six months by 16.4% (10). The medical or nutritional recommendation of the opportune time for the introduction of CA was followed by 77.4% of mothers (48). 44.8% of mothers (26) started complementary feeding with mashed baby food; 20.7% (12), with crushed or shaved fruits; 17.2% (10), with mashed vegetables; 12.1% (7), with liquefied foods; and 5.2% (3), with juice.

We identified a significant association between the beginning of the introduction of complementary food (CF) with the liquidized consistency and the defensive behavior of arching the body in the last month ( $p=0.001$ ). All children who were exposed to liquefied consistency, when starting CF, arched their bodies evasively at the time of the meal.

When asked if they found it difficult to feed their children in the last month, 43.5% (27) of the mothers or their substitutes stated that they did. After applying the checklist, 69.4% of them (43) reported some type of difficulty. Children on exclusive breastfeeding up to the sixth month of life showed a lower tendency to refuse food (96.2% - 25) ( $p=0.018$ ). Table 2 shows the frequency of the defensive behaviors found.

Oral motor dysfunction (OMD) is shown in Table 3, segmented by the assessments of each skill. We found no significant association in the bivariate analysis between oral-motor dysfunctions and eating difficulties, and we did not perform multivariate analysis.

Gestational age at birth was associated with feeding difficulties ( $p=0.005$ ), as well as refusal to open the mouth ( $p=0.009$ ) and food refusal ( $p=0.003$ ). Of these, 80.0% (8) of the extreme PTNBs refused to open their mouths, and 60.0% (6) refused food, in the parents' view.

The time of use of the tube for enteral feeding had a significant association with the feeding difficulty that was informed by the mother. Among the children who used a tube for more than 50 days, 72.7% (8) evolved with difficulties, according to the mother's perception ( $p = 0.044$ ). Likewise, 75% of babies (9) who needed positive airway pressure (CPAP) in the period of two to four weeks progressed with difficulty ( $p = 0.013$ ).

The time of use of parenteral nutrition (PN), in the neonatal period, was statistically associated with the mother's report regarding feeding difficulties in the last month. Concerning children who stayed 50 days or more with PN, 40.5% of parents (15) stated that they evolved with difficulty in the last month ( $p = 0.039$ ). Of those who remained for 29 to 49 days with PN, 75.0% (3) evolved with an exacerbated nausea reaction ( $p = 0.009$ ), selectivity ( $p = 0.040$ ), difficulties in accepting solid foods ( $p = 0.011$ ), difficulties with chewing or swallowing ( $p = 0.043$ ) and refusal to open their mouths ( $p = 0.039$ ), which shows a significant association.

## DISCUSSION

The study sought to investigate the association between oral motor dysfunction (OMD) and eating difficulties, in the period of introduction of complementary feeding, in a sample of

**Table 2.** Frequency of defensive behaviors presented by children born preterm, Salvador (BA), 2018.

Variables	N=43	%
Refuse to open mouth	23	37.1
Body Arching	18	29.0
Selectivity	17	27.4
Feeding refusal	13	21.0
Increased time*	11	17.7
Difficulty to chew and swallow	11	17.7
Nausea	10	16.1
Refuses solid	9	14.5
	4	6.5

\*Increased mealtime (>40 minutes)

**Table 3.** Distribution of frequencies of oral motor dysfunction in children born preterm, Salvador (BA), 2018.

Variables	N° of children evaluated	N (%)
<b>OSS</b>		
Incoordination	27	6 (17.1)
Inadequate sealing	35	5 (14.3)
Adequate latching	15	1 (6.7)
<b>OSS</b>		
Inadequate grip	45	25 (55.6)
Inadequate intake	45	24 (53.3)
Escape presence	45	17 (37.8)
<b>OSRFS</b>		
Inadequate intake	35	17 (48.6)
Inadequate tongue movement	34	7 (20.6)
Escape presence	35	6 (15.1)
<b>COS</b>		
Inadequate masticatory pattern	35	10 (28.6)
Inadequate grip	35	8 (22.9)
Escape presence	35	5 (14.3)

**Captions:** OSS=oral suction skill; OSDC=oral skill to drink from a cup; OSRFS=oral skill to remove food from a spoon; COS=chewing oral skill.

children born preterm and found no association between these variables. We found no studies in the literature that sought to associate these variables in this specific population. However, the study<sup>(19)</sup> that characterized the profile of varied oral skills for feeding in a group of children with different gestational ages and diagnosis of feeding difficulty (FD) demonstrated association only between the inappropriate use of utensils and the caregivers' misperception about the difficulties investigated, according to the classification by Kerzner *et al.*<sup>(20)</sup>.

The results of this research show that the large number of variables involved in oral skills for feeding, as well as what is expected for each child development milestone, highlights the importance of studies carried out with predetermined age groups.

The data from this research show that children exposed to exclusive breastfeeding (EB) up to the sixth month of life tend to refuse food less. This result, coupled with the greater chance of infants on artificial breastfeeding, have difficulties in complementary feeding<sup>(21)</sup>, supports the claim that the introduction of complementary foods is easier in breastfed children<sup>(22)</sup>.

Complementary feeding was introduced at six months of age, corrected by a little more than half of our sample, although many mothers who did it before this milestone were still found.

Authors state that the early introduction of complementary foods appears to be initially influenced by mothers' perceptions of their baby's needs<sup>(23)</sup>. This is a common practice in Brazil, with a variation of 13.8% to 17.8% of interruption of breastfeeding in the first month of life<sup>(24)</sup>. The beginning of complementary feeding, before six months of CGA, does not improve the growth of premature babies and increases the risk of hospitalization due to morbidities, such as diarrhea and pneumonia<sup>(3)</sup>.

There is oral motor dysfunction (OMD) in the sample of the present study, even though it did not occur with a uniform pattern. A large number of studies were identified with children with OMD, born at different gestational ages and evaluated in different age groups<sup>(6-15,25)</sup>. The OMD of inadequate grasp, in the ability to sip from the cup, and the inadequate collection of the spoon were the most frequent in the sample. Both require refinement of the lip function regarding the utensil offered<sup>(5)</sup>. A study<sup>(25)</sup> demonstrated immaturity in lip function in infants at four months and 12 months of age, presenting 73.5% OMD at six months, all of them with corrected age.

The parents' perception of eating difficulties is the only way to identify them in the child population since they are the ones who experience the child's daily life. When asked if they found difficulties in the last month to feed their children, almost half of the sample said yes, with a surprising increase when asked about the occurrence of specific defensive behaviors. Studies with large samples were carried out by applying questionnaires to parents and found that premature children are at greater risk for eating difficulties when compared to those born at term, although difficulties are common in children born at term as well. Therefore, health teams must detect parents' discomfort with infant feeding to better treat children<sup>(9,10,15)</sup>.

Exclusive exposure to liquidized food at the beginning of CF was associated with the defensive behavior of arching the body at the time of the offer, in the last month. Those babies who do not try textured foods in the first year of life have difficulties accepting them afterwards<sup>(26)</sup>.

Gestational age at birth was associated with the investigated defensive behaviors, such as feeding difficulties and refusal to open the mouth. Studies carried out corroborate this data and affirm the increased risk of extremely premature infants for the development of eating problems and OMD<sup>(9,12,14,27)</sup>.

The prolonged time of using a tube for enteral feeding and the use of positive airway pressure (CPAP) was associated with the feeding difficulty reported by the mother. Researchers<sup>(6,15)</sup> endorse that children exposed for a long time to nasogastric tubes are at increased risk of presenting difficulties and more facial defensive behaviors. In contrast, others deny the relationship or association of OMD and (or) dietary difficulties with different neonatal risk factors, such as gestational age and birth weight, use of oxygen therapy, use of the tube, respiratory support, asphyxia, percentile curve, and intratracheal tube time and delay to establish complete oral feeding<sup>(8,14,27-29)</sup>.

Prolonged exposure to parenteral nutrition (PN) was associated with the presence of defensive behaviors during the period of complementary feeding. Although this empirical relationship is seen in clinical practice, no studies have been found in the literature that has associated the time of use of PN

in the neonatal period with dietary difficulties in the period of introduction of complementary feeding. The extremely low birth weight newborn frequently presents food intolerance, which implies a delay in the establishment of enteral nutrition in a more opportune time, leading to the need for the use of parenteral nutrition<sup>(30)</sup>. For many preterm infants, this is the first form of diet experienced, and it appears that deprivation of the use of the gastrointestinal tract is associated with immaturity or some organic problem, with unpleasant sensations, which helps to lead these children to develop eating difficulties during the introduction of complementary food, which may or may not last.

The results found can be used as a starting point for further investigations. The themes involved in this research are multifactorial, and new studies must be carried out to verify other variables that may be involved, such as, for example, social, economic, and psychological aspects. The study, for partially relying on the collection of medical records, suffered from information bias, due to the lack of clinical data regarding the duration of use of tubes, parenteral nutrition, and mechanical ventilation. There was also a considerable difference in N between the groups, with the 'very premature' group being greater than the other groups. Such considerations demand caution in generalizing the associations observed in the side effects perceived with the study. We also highlight limitations related to the difficulty of finding summary measures of oral motor skills and dysfunctions. There are countless possibilities for understanding the functioning of these skills, as different age groups were studied, with different possibilities of ways of presenting food, including different consistencies and varied utensils.

## CONCLUSION

In this study with children born preterm, we observed difficulties in the period of complementary feeding from the reports of mothers or their substitutes, and there was no significant association between oral motor dysfunction and eating difficulties, but there was a limiting factor in the research due to the absence of essential data that were not described in the medical records and that could modify the outcome. However, defensive eating behavior was associated with gestational age at birth, the initial introduction of foods in liquidized consistency, prolonged use of an enteral tube, positive airway pressure, and parenteral nutrition.

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## Authors' contributions

CS first author, participated in the study design, data collection, analysis, data interpretation and manuscript writing. LM participated in the study design, data collection, analysis, data interpretation and manuscript writing. ACN participated in the study design, data interpretation and manuscript writing.