

Difficulties and sensory motor changes in feeding in premature infants in the first years of life

Dificuldades e alterações sensório-motoras da alimentação em prematuros nos primeiros anos de vida

Dificultades y cambios sensoriomotores en la alimentación en niños prematuros en los primeros años de vida

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Abstract

Objective: To describe the eating difficulties and changes in sensory motor aspects of feeding in the first three years of corrected age of premature infants.

Methods: Cross-sectional study with 49 premature with corrected age (GA) between 24 and 36 months, born between 2015/2017. A specific assessment instrument was used, which includes about food, assessment of the stomatognathic system and feeding. To analyze the observed effect, the sample was divided into those born with GA <32 weeks and GA > 32 weeks. Data analyzed in the XLSTAT[®] software using the chi-square test for Independence and the Monte Carlo method if categorical counts <5, significance level of 5%.

Results: Despite not having statistical significance ($p=0.138$), the GI group >32 weeks, had a lower incidence of food discomfort compared to the group <32 weeks, which showed higher frequencies of changes in oromotor aspects of feeding in pasty and solid consistencies related to lip sealing in swallowing, suggestive signs of penetration/ laryngeal aspiration and chewing.

Conclusion: Both groups presented complaints of eating difficulties, identified by changes in sensorimotor aspects of feeding. However, it was evidenced in the group of those born with less than 32 weeks more complaints of discomfort during alimentation.

Resumo

Objetivo: Descrever a ocorrência de dificuldades alimentares e alterações nos aspectos sensório-motores da alimentação nos três primeiros anos de idade corrigida de nascidos prematuros.

Métodos: Estudo transversal com 49 prematuros com idade corrigida entre 24 e 36 meses, nascidos entre 2015 e 2017. Empregou-se instrumento específico de avaliação, contemplando queixas sobre alimentação, avaliação do sistema estomatognático e alimentação. Para análise do efeito observado, dividiu-se a amostra em nascidos com idade gestacional <32 semanas e idade gestacional >32 semanas. Dados analisados pelo software XLSTAT[®] aplicando o teste de qui-quadrado para independência de variáveis e o Método de Monte Carlo, nível de significância de 5%.

Resultados: Apesar de não ter significância estatística ($p=0,138$), o grupo IG>32 semanas apresentou menor incidência de desconforto alimentar comparado ao grupo <32 semanas; este apresentou maiores frequências de alterações oromotoras da alimentação, para as consistências pastoso e sólido, em relação ao vedamento labial na deglutição, sinais sugestivos de penetração/ aspiração laríngea e na mastigação.

Conclusão: Os dois grupos avaliados apresentaram queixas de dificuldades alimentares, identificadas pelas alterações nos aspectos sensório-motores da alimentação. No entanto, no grupo dos nascidos com menos de 32 semanas, observaram-se mais queixas de desconforto durante a ingestão alimentar.

Resumen

Objetivo: Describir las dificultades alimentarias y cambios en los aspectos sensoriomotores de la alimentación en los primeros tres años de edad corregida en bebés prematuros.

Métodos: Estudio transversal con 49 prematuros con edad corregida entre 24 y 36 meses, nacidos entre 2015 y 2017. Se utilizó un instrumento de evaluación específico, que abarcó quejas sobre la alimentación, evaluación del sistema estomatognático y nutrición. Para analizar el efecto observado, la muestra fue separada en nacidos con edad gestacional <32 semanas y edad gestacional >32 semanas. Datos analizados por el software XLSTAT[®] aplicando la prueba de chi cuadrado para independencia de variables y el Método Monte Carlo, nivel de significancia del 5%.

Resultados: A pesar de no ser estadísticamente significativo ($p=0,138$), el grupo de prematuros >32 semanas tuvo una menor incidencia de malestar alimentario en comparación con el grupo <32 semanas; esto mostró mayores frecuencias de cambios oromotores en la alimentación, para consistencias pastosas y sólidas, en relación al sellado labial durante la deglución, signos sugestivos de penetración/aspiración laríngea y masticación.

Conclusión: Ambos grupos evaluados presentaron quejas de dificultades alimentarias, identificadas por cambios en los aspectos sensoriomotores de la alimentación. Sin embargo, en el grupo nacido con menos de 32 semanas hubo más quejas de malestar durante la ingestión de alimentos.

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Descriptoros

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Introduction

With the global increase in rates of premature births, advances in technologies for assisting premature newborns (PTNB) have allowed greater survival for this group.⁽¹⁾ However, prolonged hospitalizations expose this group early to factors that can interfere with their development,⁽²⁾ mainly in sucking and swallowing functions. These factors include extreme prematurity, cerebral immaturity, long-term intubation, use of Continuous Positive Airway Pressure nasal tubes and feeding tubes for a prolonged period of time.⁽³⁾ The absence of adequate stimuli, combined with hyperstimulation resulting from neonatal intensive care, contributes to the disorganization of premature infants' tone and posture.⁽⁴⁾ This disorganization leads to difficulties in the sucking rhythm and coordination between swallowing and breathing functions (S-D-R), contributing to delays and difficulties in oromotor skill maturation.⁽⁴⁾

PTNBs in the Neonatal Intensive Care Unit (NICU) are subjected to numerous procedures, which promote stimuli that can compromise their basic functions. Among such procedures, there is the use of a gastric tube for feeding for more than three weeks, which can generate aversion to oral stimuli, changes in facial and oral sensitivity due to sensory deprivation for the beginning of feeding.⁽⁵⁾

Therefore, when offering care to PTNBs, aspects that encompass the feeding process must be considered. This involves masticatory muscle maturation and positioning, palate stimulation by the tongue as well as the orbicularis muscle that guides the growth and development of the anterior part of the stomatognathic system and the development of the bony structures of the face. An important factor in helping the adequate development of the structures necessary for nutritional function is breastfeeding.⁽⁶⁾ However, PTNBs, depending on their clinical condition, have greater difficulty breastfeeding due to complications arising from prematurity associated with maintaining milk production by mothers. It is found that the duration of exclusive breastfeeding is lower when compared to those born at term.⁽⁷⁾

In addition to the low rates of breastfeeding duration, some feeding difficulties associated with extreme prematurity are also identified, such as extreme low

weight and food refusal.⁽⁸⁾ With regard to the stomatognathic system, babies who had peri- or post-prematurity complications Natal children usually present some type of oral motor or feeding disorder.⁽⁹⁾ Furthermore, very premature children and children with feeding problems in the first two years of life demonstrate worse cognitive, language and motor functioning when compared to those who did not have feeding problems.⁽¹⁰⁾

The hypotonia characteristic of premature babies is an important risk factor for the appearance of feeding difficulties, as it compromises the motor skills essential for the successful development of oral feeding phases. In this way, eating problems can persist throughout childhood.^(11,12)

However, there is no definition of eating difficulties that is universally accepted, which can lead to delays in identifying and diagnosing the problem. Some authors⁽¹³⁻¹⁶⁾ describe feeding difficulties in premature infants during the first year of life, such as oral motor dysfunction, vomiting, gastroesophageal reflux, aspiration, choking, preference for a food consistency, extraoral escape of food, food refusal, difficulties in transitioning food consistencies as well as chewing solid foods, poor weight gain, low food intake, oral motor dysfunction, difficulties in weaning and oral hypersensitivity.

It is evident that 30% of premature babies are more vulnerable when compared to full-term babies for important feeding problems.⁽¹⁷⁾ Some feeding skills between preterm and full-term babies show different propensities over time, in which, at 37 to 40 weeks corrected, premature babies suck up to 15% less than those born at term, have weaker sucking vigor, more rest and less resistance.⁽¹⁸⁾ It is expected that, from 24 months onwards, the majority of children without complications achieve the oromotor skills essential to manage solid food.⁽¹⁹⁾

When monitoring PTNB after discharge from the NICU, a gap is identified: the need to identify possible difficulties and sensorimotor changes in feeding in the first years of life of PTNBs so that early measures can be proposed to stimulate and reduce eating problems resulting from prematurity. Based on the above, the question arises: do PTNBs have feeding difficulties and sensorimotor changes in the corrected period from 24 to 36 months? The objective, therefore, was

to describe the occurrence of feeding difficulties and changes in the sensorimotor aspects of feeding in the first three years of corrected age in premature babies.

Methods

This is an observational study, with a cross-sectional design, developed through the research project “Repercussions of prematurity: from birth to postnatal follow-up”. The study population consisted of all PTNB hospitalized from January 2015 to December 2017 and who were being monitored at the outpatient clinic of a teaching hospital in western Paraná. During this period, 335 newborns were monitored, 221 of which were high risk and 114 were very low birth weight infants admitted to the NICU under study. To select study participants, PTNB born at less than 37 weeks of gestational age (GA), hospitalized in the NICU during the period under analysis, were included. Those with craniofacial and gastrointestinal malformations, genetic alterations, diagnosis of syndromes and neurological injuries, absence from the scheduled appointment for speech therapy assessment, even after two reschedules were excluded (Figure 1). After applying the exclusion and inclusion criteria, 134 PTNBs were eligible for the research. Based on this total, the sample calculation was carried out using the GPower 3.1 program, with a sample size effect of 0.40, sampling error of 0.05 and effect size of 0.08, estimating an ideal sample of 64 PTNB. However, throughout data collection, which took place from February to November 2019, only 49 PTNBs attended scheduled appointments at the out-

patient clinic for the research’s speech-language pathology assessment.

This study adopted the definition of prematurity proposed by the World Health Organization, in which every child born with less than 37 weeks of GA is considered a PTNB. Furthermore, prematurity was classified according to GA at birth: 1) <28 weeks, extremely premature; 2) between 28 and <32 weeks, very premature; and 3) between 32 and <37 weeks, moderate preterm or late preterm.⁽²⁰⁾ Based on this classification, the sample was distributed into two groups: those born with a GA of less than 32 weeks, i.e., those considered extremely premature and very premature (GI), and those born with a GA greater than or equal to 32 weeks (GII), moderately premature and late.

The outcome variable of this study was considered to be dysfunction in sensorimotor aspects and feeding difficulties presented by groups of premature babies. The explanatory variable was the degree of prematurity.

Data collection was carried out by the main researcher, a speech therapist, following the specific speech therapy assessment protocol for standardized nutrition for children.⁽²¹⁾ Data collection took place at the risk follow-up clinic, according to prior scheduling, carried out by the researcher via telephone contact with mothers/caregivers, when children had a corrected age between 24 and 36 months. Assessment was confirmed by the researcher herself when analyzing the video recording of each service, at which time the Speech-Language Pathology Assessment of Feeding for Pediatrics checklist was completed.⁽²¹⁾

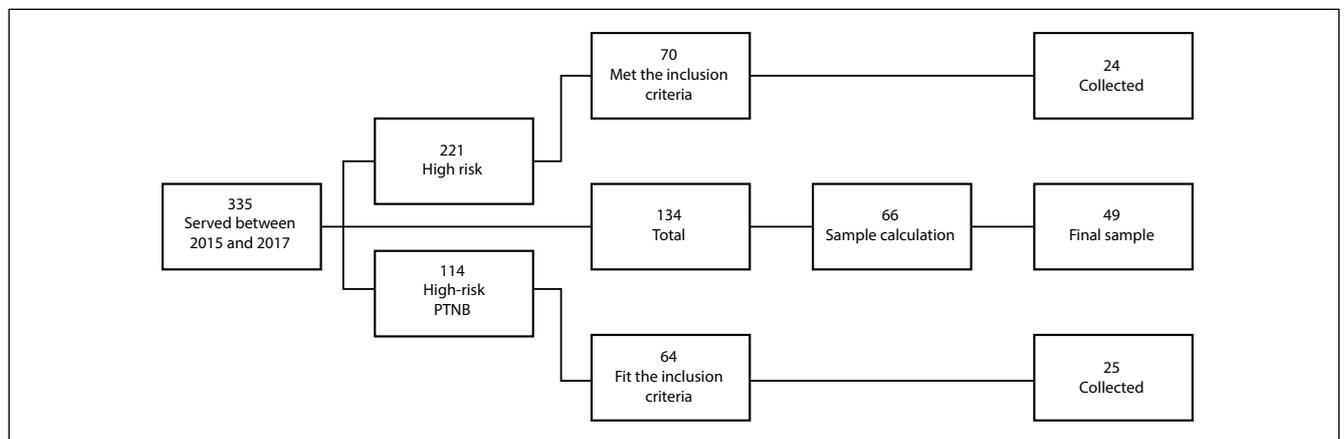


Figure 1. Sample design

The variables studied refer to PTNB characterization and data from the speech therapy assessment of systematized feeding,⁽²¹⁾ containing information regarding current feeding, preferences for a certain food consistency, refusal, nausea, discomfort during feeding and oral habits. The tone and mobility of the lips, tongue and cheeks, facial and intraoral sensitivity, through touching specific points, and the shape of the hard palate and dentition were also investigated.

This assessment made it possible to identify whether there were any changes in the oral cavity and in the stomatognathic system organs. It also included the functional assessment of the functions involved in feeding, represented by chewing and swallowing, in the case of ingesting solid, liquid and pasty consistencies.⁽²¹⁾ In this study, the foods chosen were *petite suisse*, sweet biscuits and water. For the functional assessment, children's mother/caregiver was asked to request the food. At this stage of assessment, recording was carried out through video recording for later analysis.

The occurrence of eating difficulties was verified through the qualitative variables food refusal, food nausea, discomfort with food and difficulties with textures in the same meal. To relate the type of feeding and duration of exclusive breastfeeding with the sensorimotor aspects of feeding, the three consistencies (solid, liquid and pasty) were assessed according to lip traction, anterior oral escape, exacerbated tongue protrusion, lip closure during swallowing and signs of laryngeal penetration/aspiration, and incision and mandibular movements (chewing), the latter being only for solid foods.

The data were entered into an Excel database, with double checking, and analyzed using the XL-STAT® statistical software (Addinsoft, 2017), assuming a significance level of 5%. Statistical analysis to compare the two sample groups was performed using the chi-square test for independence of variables. In conditions where categorical counts lower than 5 were detected, the Monte Carlo Method was adopted, which refers to the statistical simulation technique that uses sequences of random numbers to develop simulations, commonly using the verification of accuracy and validity intervals of analytical models.

This study met national ethical standards and was approved by the Research Ethics Committee of UNIOESTE, under Opinion 2.625.378.

Results

PTNBs were assessed in relation to current feeding difficulties and sensorimotor changes. Variables related to eating difficulties were related to current eating, refusal to eat, occurrence of nausea and discomfort during eating, as described in Table 1.

Table 1. Presence and type of feeding difficulties presented by premature babies according to the degree of prematurity

Variables	Category	Extreme and very premature (GI) - n = 25 n(%)	Moderate and late preterm newborns (GII) - n = 24 n(%)	p-value*
Difficulties in eating currently	Yes	8(32)	5(20.83)	0.376
	No	17(68)	19(79.19)	
Food refusal	Yes	3(12)	3(12.5)	0.957
	No	22(88)	21(87.5)	
Occurrence of nausea	Yes	4(16)	2(8.33)	0.413
	No	21(84)	22(91.67)	
Discomfort while eating	Yes	6(24)	2(8.33)	0.138
	No	19(76)	22(91.67)	

*Chi-square test for independence

No statistically significant differences were observed between the groups regarding eating difficulties (Table 1). To identify sensorimotor changes, according to GA (<32 weeks and >32 weeks), the duration of breastfeeding and the types of food consistencies introduced were compared with the characteristics of the stomatognathic system of preterm newborns, as can be seen in Table 2.

It was observed that those born with a GA <32 weeks did not maintain exclusive breastfeeding until six months. On the other hand, almost half of PTNBs with more than 32 weeks of GA were exclusively breastfed for six months or more. For liquid or pasty foods, there were no statistically significant differences in relation to lip traction, anterior oral escape, exacerbated tongue protrusion or lack of lip closure during swallowing. In relation to solid foods, a significant difference was observed between the two groups only for lip traction (Table 2). Table 3 characterizes PTNBs regarding infant milk formula introduction, time of introduction, bottle use and pacifier use.

The milk formula was introduced before six months more frequently among PTNBs in GI (20;80%), when compared to G II (13; 54.17%) (Table 3).

Table 2. Exclusive breastfeeding time, consistency of food introduced and changes in the stomatognathic system according to the degree of prematurity

Variables n(%)	Category n(%)	Extreme and very premature (GI) - n = 25	Moderate and late preterm newborns (GII) - n= 24	p-value*	
Exclusive breastfeeding time	Non-exclusive/not breastfed	19(76)	5(20.83)	<0.0001	
	< 6 months	1(4)	8(33.33)		
	> 6 months	5(20)	11(45.83)		
Solid	Lip prehension	Yes	22(88)	15(62.5)	0.038
		No	3(12)	9(37.50)	
	Anterior oral escape	Yes	0(0)	2(8.33)	0.140
		No	25(100)	22(91.67)	
	Exacerbated tongue protrusion	Yes	5(20)	5(20.83)	0.942
		No	20(80)	19(79.17)	
	Lip closure when swallowing	Yes	24(96)	24(100)	0.322
		No	1(4)	0(0)	
	Signs suggestive of laryngeal penetration/aspiration	Yes	1(4)	0(0)	0.322
		No	24(96)	24(100)	
Chewing	Incision	Side	1(4)	2(8.33)	0,527
		Previous	24(96)	22(91.67)	
	Jaw movement	Does not chew	1(4)	0(0)	0,475
		Verticalization	10(40)	7(29.17)	
		Bilateral rotation	14(56)	17(70.83)	
Liquid	Lip prehension	Yes	21(84)	21(87.5)	0.726
		No	4(16)	3(12.5)	
	Anterior oral escape	Yes	5(20)	3(12.5)	0.477
		No	20(80)	21(87.5)	
	Exacerbated tongue protrusion	Yes	2(8)	2(8.33)	0.96
		No	23(92)	22(91.67)	
Lip closure during swallowing	Yes	24(96)	23(95.83)	0.976	
	No	1(4)	1(4.17)		
Pasty	Lip prehension	Yes	24(96)	24(100)	0.322
		No	1(4)	0(0)	
	Anterior oral escape	Yes	4(16)	2(8.33)	0.413
		No	21(84)	22(91.67)	
	Exacerbated tongue protrusion	Yes	7(28)	3(12.5)	0.178
		No	18(72)	21(87.5)	
	Lip closure when swallowing	Yes	25(100)	24(100)	-
		No	0(0)	0(0)	
Signs suggestive of laryngeal penetration/aspiration	Yes	1(4)	0(0)	0.322	
	No	24(96)	24(100)		

*Chi-square test for independence of variables

Discussion

The occurrence of feeding difficulties and changes in the sensorimotor aspects of eating result from an inadequate feeding process. This process involves the participation of the central and peripheral nervous systems, oropharyngeal mechanism, cardiopulmonary system and gastrointestinal tract, in addition to the craniofacial structures and musculoskeletal system. To occur properly, it requires coordination between structures, which is only possible through the development of skills according to the children's stage

of development.⁽²²⁾ As a result, premature babies are more vulnerable to the maturation and development of structures that help acquire skills, not only when starting a diet during hospitalization, but throughout their first years of life.

Based on information regarding the assessment of current feeding and the sensorimotor aspects of feeding when PTNB were between 24 and 36 corrected months, complaints of difficulties in feeding, food refusal and occurrence of nausea were evident in both groups assessed. However, regarding the occurrence of discomfort during eating, it was observed that

Table 3. Period of infant milk formula introduction into the diet and use of bottles and pacifiers depending on the degree of prematurity

Variables	Category	Extreme and very premature (GI) - N 25 n(%)	Moderate and late preterm newborns (GII) - N 24 n(%)	p-value
Infant milk formula introduction	Yes	21(84)	11(45.83)	0.005
	No	4(16)	13(54.17)	
Time of infant milk formula introduction	Before 6 months	20(80)	9(37.5)	0.0066
	After 6 months	1(4)	2(8.33)	
	Did not use	4(16)	13(54.17)	
Bottle use	Yes	19(76)	19(79.17)	0.7906
	No	6(24)	5(20.83)	
Pacifier use	Yes	10(40)	11(45.83)	0.68
	No	15(60)	13(54.17)	

Chi-square test for independence of variables

moderate or late PTNBs present less discomfort when compared to the group of extreme premature and very premature PTNB.

Evidence points to greater feeding difficulties in moderate and late preterm infants at two years of age when compared to full-term infants, with food selectivity and oral motor disorders significantly predominating.⁽¹⁶⁾ Among those considered extremely premature and very premature, there was a greater occurrence of feeding difficulties associated with muscular hypotonia.⁽¹²⁾

The causes of eating problems can be divided into organic and non-organic, and this differentiation is important to guide the appropriate time for introducing food to this group of children. Organic changes are characterized by dysphagia, aspiration, vomiting, diarrhea and failure to thrive, requiring specialized assessment. Incoordination between swallowing and breathing may present signs such as coughing or choking, as well as silent aspiration, without obvious signs.⁽²³⁾

Non-organic eating disorders involve inappropriate eating behaviors, which manifest themselves in the absence of an underlying medical condition, such as food selectivity (limited diet), harmful and/or forced eating, sudden cessation of eating after the occurrence of an event, anticipated choking, failure in food.^(23,24) However, with improvements in neonatal assistance and care, there is a low prevalence of feeding difficulties at three years of PTNB, similar to the group of full-term newborns.⁽¹⁹⁾

When assessing the sensorimotor aspects of nutrition, food consistency has an important influence on the development pattern of the stomatognathic system in children, impacting orofacial muscle strength, speech articulation and swallowing. This is often related to problems with eating function and can cause or increase craniofacial imbalance, changes in dental occlusion, hypotonia of the orofacial muscles, changes in the temporomandibular joint, chewing pattern and swallowing.⁽²⁵⁾ Thus, considering that oral feeding is influenced by early sensory experience, babies born under 32 weeks are more exposed to changes in the stomatognathic system, both due to their degree of prematurity, which results in the use of a gastric tube for more than three weeks, and due to the delay in tests for oral feeding and interruption in ingestive and appetitive behaviors, responsible for important experiences.⁽⁵⁾

Knowing that deprivation of eating experiences contributes to delays in nutritional development, sensory interventions that influence feeding skills both during hospitalization and outpatient follow-up in the first years of life of PTNBs need to be implemented.

An even higher frequency of early weaning was identified in GA, data similar to that evidenced in research, which pointed to early weaning related to supplemented breastfeeding. The introduction of formula associated with prematurity tends to increase the negative effect on the duration of breastfeeding.⁽²⁶⁾ Rates of exclusive breastfeeding in premature infants are below that recommended by the World Health Organization, where, upon discharge from the NICU, 85.2% of PTNBs maintain exclusive breastfeeding, but this number significantly reduces to 46.3% at 30 days.⁽²⁷⁾ Due to instability and anatomophysiological immaturity, breastfeeding is a difficult process that can also be influenced by maternal psychological conditions, use of mechanical ventilation, longer hospital stay, home environment, inadequate maternal assistance from health professionals.⁽²⁸⁾

When assessing aspects relating to the infant milk formula introduction, bottles and pacifier use and possible relationships with feeding difficulties, as well as changes in the sensorimotor aspects of feeding, it was observed that the formula was introduced before 6 months of age for PTNB classified as extremely premature and very premature. This group also had more

complaints of discomfort during eating and changes in solid and pasty food assessment. As suggested in the literature, the use of infant milk formula is related to the emergence of feeding difficulties during the period of introduction of complementary feeding, increasing difficulties by 41% compared to exclusive and mixed breastfeeding.⁽²⁹⁾ When assessing the stomatognathic system of premature babies at the age of 5, evidence indicates that around 75% used a bottle early. The rates of occurrence of bite changes and palate atresia were high, indicating a possible relationship between bottle use and structural changes in the oral cavity.⁽³⁰⁾

To start complementary feeding, there must be anatomical, physiological and oral motor readiness of children. Feeding problems and feeding difficulties in preterm infants are common, especially among extremely premature infants. Approximately 30% of them presented oromotor dysfunction or avoidant behavior at three months. Therefore, an individualized approach should be used as a strategy for dietary guidance, based on premature infants' neurological capacity and nutritional status.⁽³⁰⁾

It should be noted that eating difficulties can cause distress among family members, but the eating process should not cause suffering for children and their caregivers. Some problems related to eating may be transient, but other disorders require greater attention and appropriate intervention. Assessment and diagnosis are carried out by an interdisciplinary team made up of a doctor, speech therapist, nutritionist, nurse, physiotherapist and psychologist. Interdisciplinary approach allows children to be fully assessed, including their caregivers in this process.⁽¹⁷⁾

Considering that those born with less than 32 weeks up to the corrected three years are more vulnerable to presenting greater feeding difficulties related to changes in their stomatognathic system, it is suggested that future research on the proposed topic should be carried out with larger samples. In this study, sample size was a limiting factor for the investigation.

Based on the results of this study, as contributions to the healthcare practice for PTNB, the need to encourage prolonged breastfeeding is highlighted to reduce the risk of dysfunction in the stomatognathic system after discharge. Furthermore, the assessment of feeding difficulties should be included as part of the routine consultations of health professionals in out-

patient clinics monitoring high-risk newborns, since such difficulties can result in changes in the development and growth of these children as well as anxiety in caregivers.

Conclusion

The occurrence of feeding difficulties among PTNBs is present even at three years of age, a period in which most children should reach the oromotor conditions relevant for feeding and have their nutritional development stabilized. Changes were evident in the sensorimotor aspects of feeding in the first three corrected years of age of premature babies in both PTNB groups, with the extreme and very premature PTNB group (less than 32 weeks of GA) showing greater manifestations of discomfort when eating, regardless of food consistency.

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Collaborations

Cabral C, Vieira CS, Fujinaga CI and Nassar PO declare to have contributed to study design, data collection, analysis and interpretation, manuscript writing, relevant critical review of intellectual content, and approval of the final version to be published.

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