Original Article

Artigo Original

Integrated sensory motor system in prematurely born children

Sistema sensório motor integrado em recém-nascidos prematuros

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Keywords

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ABSTRACT

Purpose: To investigate about an integrated sensory motor system existence in premature newborns, submitted to gustatory stimulation. **Methods:** Analytical and experimental study of contents, double-blind. Being participants 90 premature newborns, divided into two groups (water or sucrose analysis 12%). Recorded by 15 minutes (first and last moments, without stimulation; and second time with gustatory stimulation). Three independent judges analyzed the behaviors in the right hand and left hand in the mouth and suction in the left and right and hand during the various behavioral states, those being inserted in the database of Statistical Package for Social Science, being then considered that the events observed by at least two of them. It was made use of Spearman's rank correlation test on a significance level by $p<0.05$. **Results:** Considering the groups both separately and together, right and left had initially moderate correlation, being right hand in the mouth remained strong at the end and left hand in the mouth finished on moderate and strong correlation, according to each behavioral state. Right hand suction in its total and sucrose showed a strong correlation initially in drowsy state, becoming moderate at the end. In alertness state there was initially a weak correlation in both stimuli ending in moderate correlation in sucrose and strong in water. Left hand suction presented initially moderate correlation on the alert state, ending in weak correlation in sucrose stimuli, which did not occur in the water that started and finished strong. **Conclusion:** The oral stimulation influenced the hand-mouth coordination, showing early motor sensory integration. However, there was no discrimination about the gustatory capacity on the newborns.

Descritores

Recém-nascido
Prematuro
Sucção
Idade gestacional
Lateralidade funcional
Desempenho psicomotor
Fonoaudiologia

RESUMO

Objetivo: Investigar a existência de sistema sensório motor integrado em recém-nascidos (RNs) prematuros submetidos à estimulação gustativa. **Métodos:** Estudo experimental analítico e duplo-cego. Participaram 90 RNs prematuros, divididos em dois grupos (água e sacarose para análise (PA) 12%), filmados durante 15 minutos (primeiro e último momentos, sem estimulação; e segundo momento com estimulação gustativa). Três juízes independentes analisaram os comportamentos mão na boca direita e esquerda e sucção da mão direita e esquerda durante os diversos estados comportamentais, inseridos no banco de dados do *Statistical Package for Social Science*, sendo considerados em concordância os eventos observados por pelo menos dois deles. Empregou-se teste de correlação de Spearman com nível de significância valor de $p<0,05$. **Resultados:** Tanto ao serem considerados os grupos separadamente quanto juntos, mão na boca direita e esquerda tiveram inicialmente correlação moderada, sendo que mão na boca direita manteve-se forte no final e mão na boca esquerda finalizou com correlação moderada e forte, de acordo com cada estado comportamental. Sucção de mão direita na totalidade e em sacarose apresentou-se inicialmente com correlação forte no estado sonolento, passando para moderada ao final. No estado alerta houve inicialmente correlação fraca em ambos os estímulos, finalizando com correlação moderada em sacarose e forte em água. Sucção de mão esquerda apresentou-se inicialmente correlação moderada em alerta, finalizando com correlação fraca no grupo sacarose, o que não ocorreu na água, que iniciou e finalizou forte. **Conclusão:** A estimulação oral influenciou na coordenação mão-boca, independente do estímulo, evidenciando integração sensório motora precoce, mas não inferindo sobre capacidade de discriminação gustativa nos prematuros.

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INTRODUCTION

Every year, twenty million premature and underweight children are born worldwide, a fact that can indicate a higher possibility of compromised neurobehavioral development in this population[1].

According to the World Health Organization (WHO)[2], a newborn (NB) is considered premature when the gestational age (GA) does not reach 37 weeks. The degree of prematurity is considered borderline when the GA is between 35 and 37 weeks; moderate, between 31 and 34 weeks; and extreme, below 30 weeks[3]. In regards to weight, it is classified as adequate at birth (>2500 g), low (LW – between 1500 and 2000 g), and very low (VLW– between 1000 and 1500 g)[4].

The technological advances in Neonatal Intensive Care Units (NICU), including state-of-the-art equipment, humanized formation of interdisciplinary teams, and inclusion of the family in caring for NBs have granted premature babies a higher chance of survival, instigating the interest of researchers willing to investigate their neuropsychomotor development[5-7].

The work of speech language pathologists is also part of this scenario. The aims are to detect alterations in the sensory-motor-oral system, more specifically in relation to the functions of suction, swallowing, and breathing[8], and to promote assistance with feeding in this population.

The study of the relation between human motor development and the feeding system has been contemplated in studies that involve precepts from the fields of Neurosciences and Behavior, with experiments that deal with oropharyngeal control and coordination of hand-mouth movements in human NBs[9-11].

The organization and the formation of the nervous system reflect the quality of a child's motor movements, given that motor development is a result of neurological development[12]. The changes in motor abilities over the course of a lifetime have been regarded as a result of the interaction between genetically determined biological processes and environmental factors[13].

Motor development is understood as a sequential process, continuous and related to chronological age, through which the human being acquires a large number of motor abilities that range from simple and disorganized movements to the use of highly organized and complex motor skills[14].

Although the literature still showcases opinions that motor development happens hierarchically[15], and that it is not mature at birth, causing a difficult interaction between the NB and the environment[16], the incidence of specific behaviors such as hand in the mouth and hand suction prompted by gustatory stimulation is a strong evidence of the early sensory motor integration of several functional systems[11,17].

Hand and thumb suction are universal fetal actions, which indicate that the movement of guiding the hand toward the mouth already happens in the uterus and remains present in the first hours after birth, reoccurring during 20% of the time when NBs are conscious[18-20].

The behavior of guiding the hand toward the mouth can also be understood as an evident sign that the infant is ready to be fed. Sucrose has been used in research[10,11,17] as a stimulus to elicit motor response from NBs, and it is correlated to the activation of feeding systems. In previous studies, NBs that were stimulated with sucrose at 12% remained more active and showed readiness to feed through actions such as tongue protrusion, suction movements, hands in the mouth, and hand suction[11].

Stimulation can affect motor and oral development, which changes according to the NB's corrected GA[21]. Therefore, even when suction is considered a reflex behavior, necessary to efficient oral feeding and adequate to motor-oral development[21], it can be modified according to the experiences obtained, with the first signs occurring between the 18th and the 24th week of gestation[22,23]. However, a premature newborn (PNB) may have difficulties with this behavior due to immaturity[24].

On the other hand, the tendency to prefer the right hand, typical in the adult population, seems to be already present at the beginning of life. Although this preference is more evident when children start attending school, its traces can be observed even before birth[25].

In this sense, the observation of specific behaviors (hands in the mouth and hand suction) that underlie hand preference, prompted by gustatory stimulation, can contribute to a better understanding of sensory and motor abilities in PNBs.

Thus, the aim of this study was to describe and analyze the specific behaviors — hand in the mouth and hand suction in PNBs submitted to gustatory stimulation (water and sucrose at 12%) — and to verify if there is synergy between the manual system (upper limbs) and the sensory (gustatory) system in this group .

METHODS

This study was approved by the Universidade Federal de Sergipe's Ethics Committee as part of the research project "Development of feeding functions in premature newborns," protocol number 0027.0.107.000-11. All legal guardians signed the informed consent and were assured that the data provided were to remain under confidentiality.

This is an experimental, analytical, and double-blind study. The sample was composed of 90 PNBs of both sexes, born at Nossa Senhora de Lourdes Maternity Hospital, located in Aracaju, Sergipe.

In order to be selected, the NBs had to present stable condition at the time of the test, corrected gestational age (CGA) of up to 36 weeks and 1 day, and intrauterine growth curve adequate to the gestational age (AGA). We excluded NBs with neurological and cardiac complications, syndromes and malformations, risk of hyperglycemia, and those who needed breathing support at the time of the procedure.

The NBs were randomly allocated in two groups according to the substance administered to them: water (46 individuals) and sucrose at 12% (44 individuals).

Initially, we conducted a pilot study, with the purpose of establishing the stages of the test per se, and to familiarize ourselves with the accommodations. We also unified the characteristics of the behavioral states and the specific behaviors studied and provided training to the judges who evaluated the video recordings of the NBs.

Before carrying out the procedures to be used for the analysis of the 90 NBs, we surveyed the medical charts and took note of the characterization data (GA at birth and corrected, weight, and Apgar scores registered in the first and fifth minutes of life).

After meeting the inclusion criteria, the individuals presented the following characteristics: average GA at birth (GAB – physical examination) of 34.14 weeks (standard deviation of ±1.8 day), with minimum GAB of 28.00 and maximum 36.14, and average CGA of 34.91 weeks (standard deviation of ±1.05 day), with minimum CGA of 30.14 and maximum CGA of 36.14 weeks. Regarding the individuals' weight at birth, the average was 2.110 g (standard deviation of ±0.451 g), with minimum weight of 1.080 g and maximum weight of 3.345 g.

The individuals were allocated into two substance groups, water and sucrose, administered through double-blind procedure (both the researcher and the participant did not know which substance was being used with each individual).

The test per se lasted 15 minutes, divided into three 5-minute periods that corresponded to seven moments without intervals between one another. The time period was monitored with a digital camera. Each NB was placed on a hospital crib in the supine position, with the camera stabilized by a tripod for the purposes of keeping the face and upper limbs in clear view throughout the whole experiment.

During the first 5-minute period, which corresponded to the initial baseline (BL1), no stimulation was applied. Gustatory stimulation (sucrose at 12% or water) took place in the second moment, administered orally with a disposable syringe. We offered each NB 1.0 mL (fragmented in five doses of 0.2 mL, administered in 1-minute intervals for a total of 5 minutes). During the last 5-minute period, which corresponded to the final baseline (BL2), the NBs did not receive any stimulus.

The specific behaviors and behavioral states studied were hand in the mouth, right (HMR) and left (HML) and hand suction, right (HSR) and left (HSL), deep sleep (1), light sleep (2), drowsy state (3), alert state (4), agitated/irritated state (5), and crying (6)[11].

The description and analysis of the behaviors related to different responses to the gustatory stimuli (water or sucrose) were registered with the frequency and duration of the events in the database of the software Statistical Package for Social Sciences (SPSS, version 18, 2008, Chicago, Illinois, USA). The data were then analyzed separately by three judges, and we considered a given specific behavior or behavioral state as verifiable when it was registered by at least two of the judges exactly at the same moment. In this way, we estimated the events that coincided in relation to both frequency and the moment in which they occurred.

Drawing on the data registered in the SPSS[26], we used central tendency measures (average), variability (standard deviation), and prevalence (absolute and relative) in our statistical analysis. We applied Shapiro-Wilk's test in order to verify data normality. Due to the absence of normality, we used Mann-Whitney's test to compare the averages. Spearman's correlation test was applied in order to verify the correlation between behavioral states and specific behaviors in each moment of the procedure. In accordance with the distribution of the variables studied, the correlation was considered weak between the values 0.1 and 0.3; moderate between 0.4 and 0.6; strong above 0.7; and ideal when the value was 1.0. A value of $p<0.05$ was accepted as significant.

RESULTS

We analyzed 90 premature NBs, 48.9% males and 51.1% females, with an average birth weight of 2.110 g (minimum 1.080 g; maximum 3.345 g). The average GA at birth (physical examination) was 34.14 weeks (minimum 28.00; maximum 36.14) and the average CGA was 34.91 weeks (minimum 30.14; maximum 36.14). The individuals were stimulated randomly, 46 with water and 44 with sucrose.

We will present the results of specific behaviors (HMR, HML, HSR, and HSL) in each behavioral state, observed in the groups water and sucrose, separately as well as in their totality (regardless of the stimulus received) when significant correlations were observed.

In the HMR behavior, we registered an increase in correlation from moderate at BL1 to strong at BL2 when all NBs were taken into consideration, as Table 1 summarizes.

In the behavioral states light sleep (2), alert (4), and agitated/irritated (5), an increase was verified in the correlation of the HMR behavior from moderate at BL1 to strong at BL2 in the sucrose group.

In the water group, only the drowsy state (3) did not present a strong correlation for HMR at BL2, contrary to what occurred in the sucrose group, which already presented a strong correlation at BL1 that persisted in the drowsy state (3) at BL2.

In the HML behavior, we registered an increase from moderate correlation at BL1 to strong at BL2, regardless of the stimulus, in the light sleep (2) and agitated/irritated (5) states. The opposite happened in the crying state (6), when it departed from a strong correlation at BL1 to moderate at BL2, as displayed in Table 2.

In the water group, the strong correlation of the HML behavior happened in the agitated/irritated state (5) both at BL1 and at BL2. Still in this group, we observed moderate correlation at BL1 and strong correlation at BL2 only in the crying state (6). In the light sleep (2), drowsy (3), and alert (4) states, the correlation remained moderate at BL1 and BL2.

In the sucrose group, the strong correlation of the HML behavior occurred only in the light sleep (2) and crying (6) states at BL1 and in the light sleep (2) and agitated/irritated (5) states at BL2. State (5) was the only one in which moderate correlation occurred at BL1, becoming strong at BL2.

Regardless of the stimulus, we observed a strong correlation in the drowsy behavioral state (3) and weak correlation in the alert state (4) at BL1 for the HSR behavior. At BL2, there was a strong correlation in the light sleep (2) and agitated/irritated (5) states and moderate correlation in states (3) and (4). As displayed in Table 3, we observed more occurrences of weak correlations at BL1 than at BL2 in general. In the water group, there was a weak correlation for the HSR behavior at BL1, but it was strong in the alert (4) and agitated/irritated (5) behavioral states at BL2. There was already a strong correlation for the drowsy behavioral state (3) at BL1 and weak correlation in the alert state (4). However, a moderate correlation for both states was verified at BL2.

In relation to the HSL behavior, Table 4 summarizes that the correlation was weaker at BL1 than at BL2. Moreover, a

Table 1. Correlation of the right hand in the mouth behavior with both stimuli (water and sucrose) and in the groups water and sucrose separately

Stimulus	B.S	BL1	Drop 1	Drop 2	Drop 3	Drop 4	Drop 5	BL2
	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.622*	0.532*	0.375*	0.376*	0.393*	0.317*	0.790*
	3	0.698*	0.449*	0.542*	0.319*	0.419*	0.499*	0.850*
Both	4	0.618*	0.566*	0.486*	0.488*	0.500*	0.557*	0.778*
	5	0.708*	0.323*	0.294*	0.419*	0.399*	0.384*	0.851*
	6	0.584*	0.584*	0.000	0.000	0.000	0.000	0.802*
	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.598*	0.721*	0.598*	0.464*	0.382*	0.499*	0.886*
	3	0.517*	0.000	0.000	0.000	0.494*	0.000	0.657*
Water	4	0.692*	0.514*	0.365*	0.444*	0.559*	0.492*	0.827*
	5	0.740*	0.337*	0.388*	0.546*	0.499*	0.460*	0.904*
	6	0.000	0.000	0.000	0.000	0.000	0.000	1.000*
	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.638*	0.336*	0.000	0.329*	0.394*	0.000	0.716*
	3	0.783*	0.567*	0.675*	0.406*	0.406*	0.605*	0.935*
Sucrose	4	0.567*	0.635*	0.611*	0.533*	0.420*	0.619*	0.737*
	5	0.690*	0.313*	0.000	0.160	0.000	0.271	0.758*
	6	0.000	1.000*	1.000*	0.000	0.000	0.000	0.000

*p-value<0.05

Caption: B.S. = behavioral states; BL1 = initial baseline; BL2 = final baseline; 1 = deep sleep; 2 = light sleep; 3 = drowsy; 4 = alert; 5 = agitated/irritated; 6 = crying.

Table 2. Correlation of the left hand in the mouth behavior with both stimuli (water and sucrose) and in the groups water and sucrose separately

Stimulus	B.S	BL1	Drop 1	Drop 2	Drop 3	Drop 4	Drop 5	BL2
	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.690*	0.341*	0.487*	0.395*	0.528*	0.519*	0.764*
	3	0.661*	0.000	0.000	0.230*	0.385*	0.399*	0.661*
Both	4	0.581*	0.448*	0.530*	0.691*	0.593*	0.540*	0.695*
	5	0.694*	0.350*	0.378*	0.403*	0.318*	0.484*	0.802*
	6	0.715*	0.000	0.000	0.000	0.000	0.000	0.683*
	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.626*	0.349*	0.617*	0.499*	0.510*	0.568*	0.662*
	3	0.699*	0.000	0.000	0.000	0.000	0.000	0.664*
Water	4	0.528*	0.437*	0.524*	0.693*	0.570*	0.463*	0.626*
	5	0.726*	0.426*	0.449*	0.472*	0.437*	0.633*	0.812*
	6	0.590*	0.000	0.000	0.000	0.000	0.000	0.788*
	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.752*	0.332*	0.332*	0.264	0.531*	0.464*	0.842*
	3	0.627*	0.000	0.000	0.302*	0.514*	0.540*	0.675*
Sucrose	4	1.000	0.525*	0.379*	0.487*	0.516*	0.391*	0.260*
	5	0.646*	0.222	0.276	0.276	0.000	0.222	0.782*
	6	1.000*	0.000	0.000	0.000	0.000	0.000	0.000

*p-value<0.05

Caption: B.S. = behavioral states; BL1 = initial baseline; BL2 = final baseline; 1 = deep sleep; 2 = light sleep; 3 = drowsy; 4 = alert; 5 = agitated/irritated; 6 = crying.

strong correlation was observed only in the agitated/irritated behavioral state (5) and moderate correlation only in the alert state (4) at BL1. However, there was a strong correlation in the light sleep (2) and drowsy (3) states at BL2 and moderate correlation in the alert state (4).

In the sucrose group, a strong correlation was found in the alert (4) and agitated/irritated (5) behavioral states at BL1 and in the light sleep (2), drowsy (3), and agitated/irritated (5) states at BL2. In the water group, there was moderate correlation in the alert state (4) and strong correlation in the agitated/

Table 3. Correlation for the right hand suction behavior with both stimuli (water and sucrose) and in the groups water and sucrose separately

Stimulus	E.C.	LB1	Drop 1	Drop 2	Drop 3	Drop 4	Drop 5	BL2
Both	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.000	0.703*	0.000	0.000	0.000	0.703*
	3	0.747*	0.000	0.000	0.643*	0.783*	0.437*	0.457*
	4	0.294*	0.530*	0.561*	0.386*	0.414*	0.393*	0.695*
	5	0.000	0.000	0.000	0.000	0.571*	0.584*	0.812*
	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Water	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.000	0.699*	0.000	0.000	0.000	0.000
	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.365*	0.534*	0.382*	0.535*	0.464*	0.395*	0.783*
	5	0.000	0.000	0.000	0.000	0.564*	0.590*	0.807*
	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sucrose	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3	0.716*	0.000	0.000	0.655*	0.793*	0.425*	0.468*
	4	0.216*	0.533*	0.649*	0.238	0.379*	0.389*	0.652*
	5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000

*p-value<0.05.

Caption: B.S. = behavioral states; BL1 = initial baseline; BL2 = final baseline; 1 = deep sleep; 2 = light sleep; 3 = drowsy; 4 = alert; 5 = agitated/irritated; 6 = crying.

Table 4. Correlation for the left hand suction behavior with both stimuli (water and sucrose) and in the groups water and sucrose separately

Stimulus	E.C.	LB1	Drop 1	Drop 2	Drop 3	Drop 4	Drop 5	BL2
Both	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.000	0.584*	0.584*	0.000	0.584*	0.802*
	3	0.000	0.000	0.000	0.000	0.711*	0.711*	1.000*
	4	0.663*	0.344*	0.478*	0.633*	0.736*	0.478*	0.607*
	5	1.000*	0.000	0.000	0.000	0.000	0.000	0.000
	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Water	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.000	1.000*	1.000*	0.000	1.000*	0.000
	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.535*	0.000	0.659*	0.462*	0.491*	0.493*	0.340*
	5	1.000*	0.000	0.000	0.000	0.000	0.000	0.000
	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sucrose	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.000	0.000	0.000	0.000	0.000	1.000*
	3	0.000	0.000	0.000	0.000	0.715*	0.715*	1.000*
	4	0.741*	0.438*	0.315*	0.752*	0.882*	0.488*	0.759*
	5	1.000*	0.000	0.000	0.000	0.000	0.000	0.000
	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000

*p-value<0.05.

Caption: B.S. = behavioral states; BL1 = initial baseline; BL2 = final baseline; 1 = deep sleep; 2 = light sleep; 3 = drowsy; 4 = alert; 5 = agitated/irritated; 6 = crying.

irritated state (5) at BL1. A weak correlation was detected in the alert state (4) at BL2.

DISCUSSION

The specific behaviors and each behavioral state analyzed here will be discussed in light of investigative studies on the existence of an integrated sensory motor system in NBs.

Previous works on the use of sucrose with human beings[9–11] have evidenced that each NB reacts differently to stimulation, responding positively to a stimulus that suits his/her needs or presenting movements of refusal or protection in face of stimuli considered harmful or invasive to his/her organism[17]. However, the data obtained in this study indicate that the ability for gustatory discrimination is not as heightened in premature NBs as it is in full-term NBs[11,17]. In the latter, the behavior of guiding the hands toward the oral region suggests a better sensory motor integration when stimulated with a sweet substance, which indicates a preference for stimuli that are considered pleasurable[17].

The results point that the premature NBs presented correlations that were predominantly moderate at BL1 and strong at BL2 in relation to the HMR behavior, regardless of the stimulus received. The same occurred when the groups were taken into consideration separately (water and sucrose).

The occurrence of similar results in the population of PNBs, in both groups, leads us to infer that the simple fact that they were stimulated, regardless of the type of gustatory stimulus, contributed to triggering motor responses[9].

Nevertheless, other studies conducted with full-term NBs[11,17] have presented different results and statistically significant differences between the groups, with a marked preference for sucrose stimuli.

It is worth noting, however, that a wide spectrum of internal and external factors can prompt specific behaviors[8]. Therefore, in favoring the transport of hands toward the mouth, oral stimulation possibly shows the early expression of an action performed with a purpose, to the extent that some elements of intentionality are present in this behavior[10,17]. Although we did not find significant results concerning the preference for a specific gustatory stimulus, it was possible to observe an increase of correlations for manual synergy following oral stimulation in the premature NBs of this study.

The data obtained from observing the HML behavior highlight the predominance of a strong or moderate correlation at BL1 and BL2 when the NBs were analyzed in their totality or separately in the groups (water and sucrose). However, oral stimulation did not trigger HML behavior as much as HMR behavior, indicating stronger correlations in specific behaviors on the right side of the body, regardless of the gustatory stimulus received.

The results of this study are consistent with other works about the influence of gustatory stimuli upon motor control found in literature[11,17], in the sense that other authors report a more effective integrated sensory motor system related to the right upper limb.

In regards to HSR, gustatory stimulation enabled an increase of the correlation in both groups. However, we found a strong correlation for sucrose and moderate correlation for water in relation to HSL behavior at BL1 and BL2 in the alert state. Therefore, when it comes to the left side of the body, it is worth highlighting that our findings corroborate other studies in which sucrose has elicited motor responses from NBs on the left side of the body as well, activating a synergetic relation between the manual system (upper limbs) and the sensory (gustatory) system in premature NBs[10,11,17].

Research studies[10,11] report that, at birth, the hand–mouth coordination is controlled by oral stimulation, elucidating the existence of a NB's feeding mechanism, given that the behavior of sucking hands is linked to suction, swallowing, and breathing, which have the role of nourishing human beings already in the first moments of life[17].

It is important to consider that, in a study carried out with full-term NBs[11,17], there was a significant difference in the HSR behavior between the water and sucrose groups, with more significant responses prompted by stimulus with sucrose. This finding evidences a more effective integrated sensory motor system related to the right side of the body, which is connected to a NB's ability to discern and prefer a certain gustatory stimulus. However, significant differences were not found between the groups in the NBs of the study in question, and this aspect is understood as possibly related to prematurity.

Considering the population studied here, it is possible to comprehend that there is an integrated sensory motor system in premature NBs, observed through the incidence of the specific behaviors hand in the mouth and hand suction[11,17,27,28] when stimulated orally. However, the NBs' sensory abilities in discriminating different tastes, thus demonstrating preference for certain gustatory stimuli, did not occur in the same manner as reported in studies conducted with full-term NBs[11,17].

In short, when prompting hand-mouth coordination, gustatory stimuli point to the existence of sensory motor integration already at an age that corresponds to the fetal period, considering that the average of 34.91 weeks of life and 2.11 kg refer to the NBs classified as moderate in terms of prematurity and underweight, respectively, as described by the WHO[2]. This affirmation is supposedly demonstrated by the responses obtained from the premature NBs, which point to the existence of a "feeding system" evidenced by the increase of the correlation of the hand in the oral region behavior when they were submitted to gustatory stimulation.

It is worth highlighting, however, that there was no evidence of discrimination and/or gustatory preference in the population of premature NBs with an average CGA of 34.91 weeks, which indicates the necessity for new studies on this aspect that aim at investigating if the use of gustatory stimulation can be used in the practice of speech language pathologists to stimulate feeding.

CONCLUSION

The present study evidenced a higher correlation of the behaviors of guiding the hands toward the oral region and/or sucking them after gustatory stimulation, regardless of the type of stimuli (water or sucrose) in premature NBs. Because it influences hand-mouth coordination, gustatory stimulation exposes the existence of an early integration of sensory and motor systems in the period that corresponds to an average CGA of 34.91 weeks.

In general, the premature NBs presented stronger correlations when specific behaviors on the right side of the body were stimulated, regardless of the gustatory stimulus received, but we did not obtain results as evident regarding gustatory discrimination and preference as the ones found in full-term NBs. We discussed this fact taking the GA into consideration.

Thus, the present study points to the possibility of using early gustatory stimulation to elicit motor responses from premature NBs, contributing to early sensory motor integration and possible activation of a feeding system. New studies should be conducted with the purpose of elucidating the issue of gustatory preference in this population.

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