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Original Article

Artigo Original

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Spilled volum, oxygen saturation, and heart rate during feeding of preterm newborns: comparison between two alternative feeding methods

Volume derramado, saturação de oxigênio e frequência cardíaca durante a alimentação de recém-nascidos prematuros: comparação entre dois métodos alternativos de oferta

Keywords

Newborn
Vital Signs
Premature Infant
Feeding Methods
Feeding Behavior

ABSTRACT

Purpose: To compare the use of syringe and finger feeding to feed preterm newborns considering amount of milk offered, amount of milk spilled, variation of oxygen saturation, and heart rate. **Methods**: Quasi-experimental study with 30 preterm newborns. Thirteen infants were females and 17 were males. The mean gestational age at birth and during evaluation (corrected age) was 33 4/7 ± 4/7 and 36 ± 4/7, respectively. Newborns' mean birthweight and mean weight when evaluated was 1,800 ± 140 and 1,972 ± 88 grams. We assessed one feeding session using a syringe and another feeding session using the finger feeding technique. Both techniques were used in the same infant, so that the preterm newborns were controls for themselves. A portable pulse oximeter was used to check the variation of oxygen saturation and heart rate. A gauze pad was placed under the infants' chin to absorb the spilled milk. The statistical tests used were: ANOVA, paired Student's *t* test, Tukey Multiple Comparison test, and Pearson Correlation Coefficient. The level of significance was set at 5%. **Results**: We found a difference between the techniques in terms of both amount of milk offered and amount of milk spilled. These amounts were larger when the syringe was used. Heart rate was different at two specific times: before/during and before/after feeding for both techniques. However, the values were within normal limits. Oxygen saturation values were also different, showing higher values after syringe feeding. **Conclusions**: Finger feeding proved to cause less spillage, whereas the variations of oxygen saturation and heart rate were within normal limits.

Descritores

Recém-nascido
Sinais Vitais
Prematuro
Métodos de Alimentação
Comportamento Alimentar

RESUMO

Objetivo: Comparar o uso da seringa e da técnica sonda-dedo para a oferta de dieta a prematuros, considerando-se volume de dieta oferecido e volume derramado, variação da saturação de oxigênio periférico e frequência cardíaca. **Métodos**: Estudo quasi-experimental, com 30 prematuros, 13 do gênero feminino e 17 do masculino. As médias das idades gestacionais ao nascimento e no momento da avaliação (idade corrigida) foram de 33 4/7±4/7 e 36±4/7, respectivamente. Os pesos médios ao nascimento e na avaliação foram de 1.800±140 e 1.972±88 gramas. Foi avaliado um momento de alimentação com a seringa e outro com a sonda-dedo para a mesma criança, sendo caso e controle de si mesma. Utilizou-se oxímetro de pulso portátil para verificar a variação da saturação de oxigênio e a frequência cardíaca. Uma gaze foi colocada sob o queixo do bebê como anteparo da dieta derramada. Foram utilizados os testes ANOVA, *t* de Student pareado, Comparação Múltipla de Tukey e Correlação de Pearson, com nível de significância de 5%. **Resultados**: Houve diferença para o volume oferecido e para o volume de leite derramado com os dois valores, sendo maiores quando a seringa foi utilizada. A frequência cardíaca foi diferente: antes/durante e antes/depois para ambas as formas de oferta, mas com valores considerados normais, assim como a saturação de oxigênio, que apontou aumento entre os momentos antes e depois da oferta para a seringa. **Conclusão**: A técnica sonda-dedo proporciona menor derramamento da dieta, sendo as variações da saturação de oxigênio e frequência cardíaca consideradas normais para o neonato.

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INTRODUCTION

Feeding premature newborns is a challenge due to their immaturity, and in many cases, it is necessary to use a gastric probe for a prolonged period, which limits the suction experience and maturation of oral reflexes[1-3].

In addition, there are situations that require a supplemental or alternative, safe and effective feeding method, as in the mother absence or when the premature newborns (PTNB) are not physiologically fit for breastfeeding. Accordingly, there are methods that are used in the transition from gastric tube for oral[2-5] and the offering of the diet for the newborn in the mother's absence[6]. Among the alternatives are the glass[1,7-11], the cup[6], the spoon[6] and the bottle[7,9,12], the latter being prevented by the negative impact on breastfeeding[4,5,13].

Recommended by the World Health Organization, the glass has been used on the grounds of being a practical alternative, simple and ensures breastfeeding[6]. However, there are discussions about its effectiveness, since oral movements performed by the newborn (NB) for the extraction of glass content are not of effective suction[10,14,15]. In addition, there are references of spilled offered volume and negative impact on weight gain[2,15-18].

There are other diet offer strategies often used in the routine of neonatal units; however, there are no studies that support their use. Such strategies are mentioned by the teams of caregivers as facilitators in the time of feeding transition, especially in cases of NBs with difficulties in the process[19]. Two of these supply forms are syringe[5,19,20] and the *finger feeding* or finger feeding method (FFM)[1,19,21-23].

There are no scientific studies available regarding the use of the syringe, only information on the procedures of how to use it. The orientation is that the milk is directed the child's cheek inner face and its piston pushed only when the PTNB is sucking and not in times of swallowing or breathing[20].

FFM has been suggested as an alternative in the food transition[1,20-23]. This technique involves placing a probe to the finger of the caregiver, which is sucked by the RN.

Facing the routine use of these two tools as diet offer strategies to PTNB, it was considered important to search by using objective data for both. The initial hypothesis of this study is that, during feeding, clinical stability of preterm infants and the milk spillage are influenced by supply strategies.

It is imperative that the way food is offered stimulate the oral reflexes in training situations for the establishment of the oral feeding or in the absence of the mother. Furthermore, the PTNB is already exposed to stress and sometimes lengthy periods of hospitalization. Therefore, the suction can be an important strategy for stimulating their development.

Therefore, this study aimed to compare two different forms of diet supply to the PTNB (syringe and FFM) especially regarding the amount of offered and spilled diet and the variation of parameters of peripheral oxygen saturation and heart rate.

METHODS

It is a quasi-experimental study in a public neonatal unit located in the city of Porto Velho, State of Rondonia. The hospital is the only public health unit of the State of Rondônia to offer assistance to high-risk pregnant women and low birth weight and premature infants.

The study was approved by the Ethics Committee, under the number 40928/2012. The progenitors were instructed on procedures. Those agreeing with the child's participation signed the Informed Consent Form.

The mentioned neonatal unit comprises four wards, totaling 40 beds. The wards are separated by the severity of the newborn general condition of the type of care needed. The multidisciplinary team responsible for patient care is composed of doctors, nurses, physiotherapists, speech therapists, psychologists, nutritionists and social workers.

Data collection occurred in the ward named "Intermediate I" with 14 beds. This ward serves stable NBs and remains in contact with the mother for 24 hours. In this context, all NBs are evaluated and followed by speech service, which assist in the process of feeding transition from gastric tube to oral, and encourage and support breastfeeding.

Sample characterization

According to the data of the statistical sector, in the first six months of 2012, the average number of premature births was 52 per month. The sample of 30 individuals was set from the average of births per month, considering sampling error of 12% and 95% confidence level. Therefore, over a month, the infants that met the inclusion criteria were selected for the study.

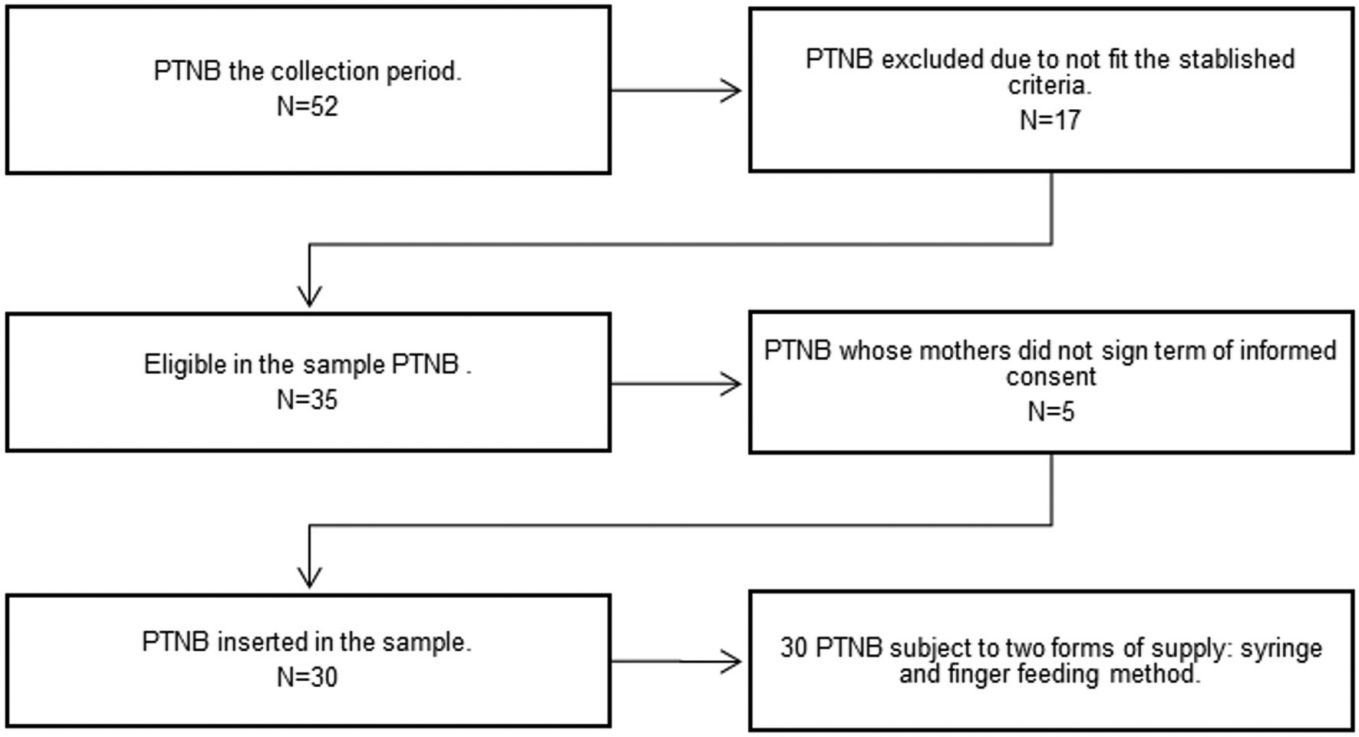
The inclusion criteria stablished, according to Figure 1 were: be a PTNB with corrected age equal or higher that 34 weeks at the time of evaluation, being orally fed for at least two days, be on alert in the evaluation, clinically stable, i.e., no need for cardiorespiratory or hemodynamic monitoring, as well as, do not present neurological disorders, chronic lung changes, congenital heart disease, craniofacial malformation and not be HIV positive for human immunodeficiency virus.

All unit PTNBs are accompanied by a speech therapist, so individuals in the sample received specific intervention for food transition according to their routine. This intervention includes evaluation and specific stimuli of oral skills and readiness to supply of NBs as well as guidance and support to breastfeeding. Thus, the PTNBs of the study were able to receive oral diet safely for at least two days.

To avoid interference of the individual characteristics of the subjects, it was decided to evaluate one time of syringe feeding and other with finger feeding for the same child, this way the child is her/his own control.

From the selected newborns, 13 were female and 17 male.

The mean gestational age at birth and during evaluation (corrected age) was 33 4/7 ± 4/7 and 36 ± 4/7, respectively.



Caption: PTNB = newborn preterm; Term of informed consent; Finger feeding
Figure 1. Sample flowchart

Newborns' mean birthweight and mean weight when evaluated was 1,800 ± 140 and 1,972 ± 88 grams.

The sample was homogeneous (Table 1), except for days of gastric probe use and days of oral fed diet, whose coefficients of variation were 70% and 82%, respectively. Of the 30 children in the sample, 18 were classified as appropriate for gestational age (AGA) and 12 as small for gestational age (SGA). To characterize the distribution of the relative frequency between them, the Two Proportions Equality Test was applied, with no difference observed (p = 0.121).

Procedures

Initially, we performed a study of data records, to select the PTNBs that met the inclusion criteria.

The materials used were not sterile gauze, examination gloves, surgical tape, disposable syringe of 20 milliliters, gavage number six, calibrated digital scale (Balmak, Easy 5, São Paulo, Brasil), handheld pulse oximeter (Moriya, MD300C1, Beijing, China, with ANVISA registration number 10349590060), digital timer (Q & Q, HS45, Tokyo, Japan) and personal protective equipment.

In the absence or inability of the mother to breastfeed, the NB received two forms of diet: syringe and FFM, respectively, in the same day, in different subsequent feeding sessions. The assessments were performed in two unique feeding moments in the morning and by two researches equally trained and calibrated.

Both methods used the following procedures: (1) 50 cm gauze used to contain any spillage diet, weighed on a precision balance; (2) care was taken in awakening the baby, it was imperative that they were alert; (3) a portable oximeter was placed in the baby's foot for verification and annotation of oxygen saturation and heart rate at the beginning, one minute after initiation of the procedure and the end of the offer; (4) the touch of the syringe or finger on the NB lips was considered the beginning and the end was established as the total acceptance of the diet or the refusal to offer attempts, this period being timed; (5) during the feeding session, the PTNB was placed on his/her bed, in an elevated position, with 45-degree slope, and the occiput and cervical sustained with the opposite hand to that used in the offer; (6) the diet was according to the pediatrician daily prescription and was made available by the unit lactary; (7) the gauze was immediately weighed at the end of the offer again to check the amount of spill.

A 20 mL syringe was chosen because it is usually provided by the service (Figure 2). The contents of the syringe were directed to the internal face of the cheek and not to the tongue or pharynx[20].

For FFM (Figure 3), one end of the gastric tube was fixed to the end of the reviewer finger and introduced into the oral cavity of the baby[20-23]. The other end of the tube was attached to a 20 mL syringe. The syringe plunger was pressed only when the suction occurred.

Regardless of the offer method, the time of offer and the total volumes offered and spilled were registered. These values were used to calculate the volume ratios, as well as their relationship with time.

Table 1. Distribution of thirty (30) subjects in relation to gestational age, weight and day by gavage feeding and oral

PTNB	PESOIG	GA	CGA	PN	PDA	DSOG	DORAL
1	SGA	36 2/7	38 2/7	1,870	1,945	12	2
2	SGA	34	36 3/7	1,605	1,855	11	10
3	AGA	30	37 5/7	1,225	1,865	52	2
4	SGA	34 2/7	40 5/7	1,430	1,986	26	18
5	SGA	35 2/7	37 2/7	2,020	1,950	5	8
6	AGA	31	37 2/7	1,125	1,920	42	2
7	SGA	34	39 5/7	1,175	1,810	38	2
8	AGA	32 3/7	37 2/7	1,615	2,160	31	3
9	AGA	30	34	1,300	1,615	21	4
10	AGA	32 6/7	37 2/7	1,670	2,270	26	2
11	AGA	33	35 3/7	1,655	1,815	15	2
12	AGA	33	35 1/7	2,100	1,960	6	10
13	AGA	33	34 4/7	2,065	1,920	6	6
14	AGA	34 2/7	35 2/7	2,085	1,920	3	5
15	AGA	33	36 2/7	1,690	1,735	37	5
16	AGA	35	36 3/7	2,905	2,825	6	5
17	AGA	31 4/7	35	2,030	2,320	22	2
18	AGA	31	35	1,510	2,040	26	2
19	AGA	33	35	1,940	1,945	12	2
20	SGA	36 1/7	37 1/7	1,885	1,725	6	2
21	AGA	33	34 5/7	2,320	2,400	7	5
22	SGA	36 6/7	41	2,130	2,010	24	3
23	AGA	32	36 6/7	1,420	1,860	32	3
24	SGA	35	37 6/7	1,530	1,605	16	3
25	AGA	35	35 4/7	2,200	2,000	2	3
26	SGA	35	38 6/7	1,980	2,100	14	2
27	AGA	34 2/7	36	2,185	2,100	9	3
28	SGA	34	38 3/7	1,530	1,875	22	10
29	SGA	35	36 3/7	1,995	1,890	8	2
30	SGA	32	34 3/7	1,817	1,735	14	4
		33 4/7*±4/7† (1 5/7‡)	36*±5/7† (1 6/7‡)	1,800*±140† (390‡)	1,972*±88† (245‡)	18.4*±4.6† (12.9‡)	4.4*±1.3† (3.6‡)

*average; † confidence interval; ‡ standard deviation
Caption: DORAL = days of oral feeding until the assessment; DSOG = Days of gastric probe use; GA = gestational age at birth (weeks); CGA = corrected gestational age at assessment (weeks); PDA = weight at assessment (grams); PESOIG = weight: gestational age ratio; PN = birth weight (grams); PTNB = preterm newborn identification

To ensure the safety of children, we considered two feeding racing parameters: the monitoring of the volume offered during the first five minutes divided by the total volume prescribed for each feeding session (which should be at least 30% of the total diet of that session) and volume of ingested milk during a complete feeding session, i.e., the relationship between the offered amount (mL) and the time (min), the minimum expected value was 1.5 mL / min[24,25].

These parameters are used in the service for the release of oral feeding. As PTNBs evaluated in this study are already in full oral feeding for at least two days, it was expected that all reached the minimum values of 30% and 1.5 mL / min, which in fact occurred. Therefore, these values were used to compare a possible variation between the two methods.

The following analyzes were performed: (1) comparison of diet offered proportions and poured, and when the total time of power between the two types of supply by the paired *t* Student test; (2) correlation between the supply volumes and time and PTNB characteristics such as gestational age at birth and corrected gestational age, birth weight and weight at the time of assessment, day use of gastric tube and days of oral, using Pearson correlation test; (3) comparing the variation of oxygen saturation and heart rate in three stages before, during and after feeding for each form of supply by statistical tests ANOVA and Tukey Multiple Comparison.

Data were organized in Office Excel 2010 spreadsheet and analyzed by *software* SPSS V17. The results showed a normal distribution, with a level of statistical significance of 5%.

RESULTS

Table 2 contains the interference of the relationship between weight and gestational age in the diet proportions offered, diet and poured time. It can be observed that the SGA PTNB showed greater volume provided than the PTNB AGA when

the FFM was used. In other aspects evaluated, the results were the same.

Table 3 shows the comparison of ratios offered diet, diet and poured time between the two types of supply, which demonstrated difference in volume and poured offered.

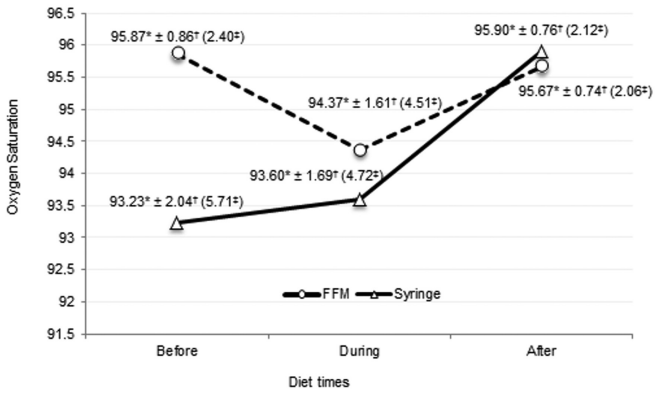
Figure 2. Offer diet by syringe. Source: Newborn assisted at the hospital where the study was performed. Photographic record authorized by genitor

Figure 3. Offer diet by finger feeding. Source: Newborn assisted at the hospital where the study was performed. Photographic record authorized by genitor

To measure the degree of relationship between the characteristics of NB which could interfere in the forms of supply was applied Pearson correlation, shown in Table 4. The results showed correlation present only for the FFM and the corrected age.

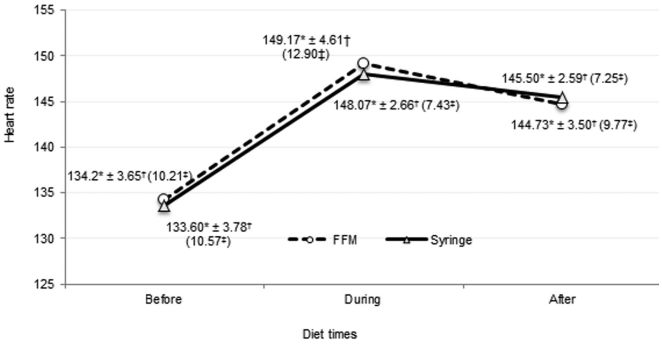
The values of oxygen saturation, which were recorded at three times (before, during and after) for the two forms of dietary supply are shown in Figure 4. We used the ANOVA test to compare these times each technique. For the FFM, the comparison does not indicate change in this parameter. There was difference for syringe (p=0.047). To observe when the difference occurred, it was applied to multiple comparison Tukey, which showed an increase in oxygen saturation between the moments before and after the supply (p = 0.05).

Figure 5 shows the heart rate values obtained are in three stages (before, during and after) for the two forms of dietary supply. ANOVA was used to compare these times, indicating differences for both techniques (p <0.001). The Tukey's Multiple



Caption: * average; † confidence interval; ‡standard deviation

Figure 4. Data of the oxygen saturation were measured before, during and after the supply of the diet of the individuals to the two forms of supply, finger feeding and syringe



Caption: * average; † confidence interval; ‡standard deviation

Figure 5. Data relating to heart rate were measured before, during and after the diet offer, of the individuals to the two forms of supply, finger feeding and syringe

Table 2. Data regarding the offered diet proportion, spillage and time for each type of offer, considering the gestational age/weight ratio for the 30 (thirty) individuals assessed

Variables	Finger feeding method		P-value	Result	Syringe		P-value	Result
	AGA (n = 18)	AGS (n = 12)			AGA (n = 18)	AGS (n = 12)		
Offered volume (%)	69.6*±10.2† (22.0‡)	18.4*±4.6† (12.9‡)	0.003	AGA#AGS	87.0*±6.7† (14.4‡)	91.5*±6.5† (11.5‡)	0.383	AGA=AGS
Offered volume in 5 min (%)	35*±4.9† (10.5‡)	41.5*±6.5† (11.4‡)	0.122	AGA=AGS	38.6*±4.0† (8.6‡)	40.3*±5.4† (9.5‡)	0.608	AGA=AGS
Spilled volume (%)	2.3*±1.9† (4.1‡)	2.4*±3.3† (5.8‡)	0.965	AGA=AGS	16.6*±3.5† (7.6‡)	17.9*±4.0† (7.1‡)	0.634	AGA=AGS
Volume/time ratio (mL/min)	3.04*±0.45† (0.97‡)	3.42*±0.57† (1.01‡)	0.316	AGA=AGS	3.34*±0.31† (0.68‡)	3.27*±0.51† (0.90‡)	0.827	AGA=AGS
Time (min)	9.90*±1.45† (3.14‡)	11.38*±1.77† (3.13‡)	0.218	AGA=AGS	11.27*±1.34† (2.91‡)	11.56*±1.41† (2.49‡)	0.781	AGA=AGS

* Average; † confidence interval; ‡ standard deviation
Caption: AGA = adequate for gestational age; SGA = small for gestational age. Statistical test: ANOVA (p <0.05)

Table 3. Comparison between two types of offer, finger feeding and syringe, regarding proportion of offered, spilled diet and time for the individuals assessed

Variables	Offer (n=30)		P-value	Result
	Finger feeding method	Syringe		
Offered volume (%)	78.9*±7.8† (21.9‡)	88.8*±4.8† (13.3‡)	0.029	FF≠syringe
Offered volume in 5 min (%)	37.6*±4† (11.2‡)	39.3*±3.2† (8.8‡)	0.400	FF=syringe
Spilled volume (%)	2.3*±1.7† (4.8‡)	17.2*±2.6† (7.3‡)	<0.001	FF≠syringe
Volume/time ratio (mL/min)	3.20*±0.35† (0.99‡)	3.31*±0.27† (0.76‡)	0.515	FF=syringe
Time (min)	10.49*±1.13† (3.17‡)	11.38*±0.97† (2.71‡)	0.135	FF=syringe

* average; † confidence interval; ‡ standard deviation
Caption: Statistical T test: paired t Student (p<0.05)

Table 4. Correlation of assessed individuals features with volume and proportion of offered, spilled offer and time for each type of offer (finger feeding and syringe)

Variables			GA	CGA	PN	PDA	DSOG	DORAL
Finger feeding method	Offered volume	r*	20.4%	38.0%	11.1%	26.1%	7.9%	13.4%
		p-value	0.279	0.038†	0.559	0.163	0.677	0.480
	Offered volume in 5 min	r*	5.1%	36.9%	0.1%	23.6%	23.9%	8.6%
		p-value	0.787	0.044†	0.995	0.209	0.204	0.653
	Spilled volume	r*	10.2%	8.4%	29.2%	31.7%	24.5%	21.3%
		p-value	0.592	0.660	0.117	0.088	0.193	0.259
	Volume/time ratio	r*	9.2%	40.4%	1.7%	22.4%	24.3%	24.5%
		p-value	0.630	0.027‡	0.927	0.235	0.195	0.656
Syringe	Offered volume	r*	-3.5%	32.4%	-4.4%	33.0%	17.7%	15.4%
		p-value	0.856	0.081	0.819	0.075	0.349	0.415
	Offered volume in 5 min	r*	1.0%	19.9%	-6.2%	4.1%	5.8%	13.3%
		p-value	0.958	0.292	0.743	0.830	0.761	0.483
	Spilled volume	r*	21.0%	24.5%	15.8%	9.4%	-4.8%	19.1%
		p-value	0.266	0.193	0.406	0.620	0.800	0.311
	Volume/time ratio	r*	4.1%	27.1%	-5.6%	13.5%	12.9%	8.9%
		p-value	0.830	0.147	0.768	0.478	0.498	0.641

Statistic al test: * Pearson Correlation (p<0.05); † Current correlation, classified as bad in the test scale; ‡ Current correlation, classified as regular in the test scale
Caption: DORAL = days of oral feeding until the assessment; DSOG = Days of gastric probe use; GA = gestational age at birth (weeks); CGA = corrected gestational age at assessment (weeks); PDA = weight at assessment (grams); PN = birth weight (grams)

Comparison showed the difference of two specific time points: before / during and before / after ($p < 0.001$).

DISCUSSION

We notice that the only two variables that were not homogeneous the days of gastric tube use and the days of food provided orally to the assessment day (Table 1). However, these two aspects had not influenced the results, as if it can be observed in Table 4. This finding justifies for the fact of all the PTNBs of the unit to receive multiprofessional intervention (for example: verbal stimulations), what can benefit the necessary abilities for the feeding[1,3,25,26].

We had the concern to verify if the intrauterine development could have influenced the obtained results. It is interesting to notice that the highest ratio of the offered diet volume (92.8±7.3) was presented by the PTNBs SGA and during the use of the technique that privileges the suction, that is, the FFM (Table 2). As already previously related, the sample was homogeneous; therefore, this difference was not due to the different features between the individuals, such as weight or gestational age (Table 1).

It is important to affirm that there were no episodes of diet refusal by any NB, which could affect this result. However, it can be inferred for this value that probably PTNBs SGA received, during hospitalization, more speech therapy interventions and/or be multidisciplinary in virtue of the proper condition of prematurity and low weight. Lau and Smith[3] affirms that the exercise and the practice allow that to the PTNB adapt to his/her environment and suggests that the verbal and global stimulation can speed up the normal development of varied physiological functions. Thus, when receiving the diet by means of a method that favored the suction, as the FFM, they presented better performance for the offered volume of diet. However, we did not collect data regarding the amount or type of stimuli to support this hypothesis, which can be an objective for future studies.

The differences presented between the forms of offer are related to the volume that the PTNBs had been capable to receive and to the spilling (Table 3). It can be noted that, when using the syringe, the volume injected in the oral cavity is significantly bigger when compared with the FFM; however, there is also has a bigger spilling when the syringe is used, resulting in lesser real ingestion. The bigger spilling with the use of the syringe (17.2%) can have occurred because milk flows constantly in this method and, therefore, the newborn does not have control of the inserted volume in the oral cavity. Although the syringe is commonly used in the newborn units, this method offers to an antiphysiological stimulation regardless of the will of the baby to suck or to obtain[19].

A recent study indicates the use syringe 1 mL for swallowing workout[3], while other references do not specify the size of your plunger, but refer only can be used for dietary supply[1,5,19]. As already mentioned, the 20 mL syringe was chosen because it is usually offered to NBs service where this research was conducted. However, its milk flow is probably greater than the smaller syringe plunger. Furthermore, even if the finger feeding uses a 20 mL syringe, the probe minimizes the supply flow. Therefore, the presented results cannot be assumed as what could be obtained by any syringe, in special of lesser pistons.

The answers obtained by FFM indicate a minimum loss of the diet due to spillage (Table 3). It can be inferred that this technique benefits the newborn organization of oral feeding process, as they are made sucking and swallowing movements, which can be rhythmed by who offers[22,23].

Given this result, it is clear that the technique used for feeding the NB may affect the actual volume consumed. Factors such as the oral inability of the newborn to administrate the milk flow according to the tool used may cause spillage, affecting the calories and nutrition that should be consumed[11,12,17,27].

There were no studies regarding the type of tool or method such as syringe and finger feeding, the studies are though restricted to bottle and cup[10,15,16,28]. There are only reports of FFM as strategy for transition between gastric probe to oral feeding[20,22,23]. Some authors consider that the FFM allows the rhythm and coordination of suction to be optimized[23]; however, the indication must be considered for training of suction in the absence of the mother or as supplement since the PTNB has been already breastfed[22].

Comparing the spillage found in this study, 17.2% for syringe and 2.3% for FF (Table 3) with those obtained for the average of studies with cup, of 12%[18], 38.5%[15] and 22.8%[17], it is possible to note that the FFM offers smaller spillage. This analysis concluded that the premature is unable to administer the milk flow, and the FFM allows the coordination of the newborn reflex functions, which are the suction and swallowing with the breathing[21].

The percentage of offered volume in the 5 minutes interval was 37.6±4 for FFM and 39.3±3.2 for syringe with no difference among the methods (Table 3). These values are consistent with studies monitoring the first five minutes as a power capacity rate of babies, when fatigue is minimal, and the amount offered must be at least 30% of the total prescribed volume per feeding session[24,25].

The total offered volume by feeding session and time ratio was 3.2±0.35 mL/min for FF and 3.31±0.27 mL/min for syringe and did not show any difference between the methods (Table 3). Studies states that the monitoring of a complete feeding session indicate the PTNB resistance index, because fatigue is considered maximum[24,25]. This ratio must be at least 1.5 mL/min[24,25], and the data of this study coincide with this parameter.

When analyzing the influence of the PTNBs features in both forms of supply, there was positive correlation classified in the test range as poor and fair only for the FFM and the corrected age (Table 4). Thus, for the FFM, there is a tendency that the greater the corrected age, the greater the total volume offered per feeding session, the volume offered in five minutes and the volume/time. The studies present distinct opinions as for the influence of the corrected age, as some suggest that the corrected age does not influence the offered or spilled volumes[17], while others point an association[24].

As for the oxygen saturation for each form of offers (Figure 4), there was difference only for the syringe, that showed an increase before between before and after (93.23±2.04; 95.90±0.76; p=0.05). These variations do not infer damage to the PTNBs, since they are in the normal range, that is, above 93%[29].

It was not possible to locate studies correlating the oxygen saturation to the use of the syringe or the FFM. Studies already performed mention the values of this physiological parameter for the cup and the bottle. A similar study performed in the same research unit with cups, showed a saturation variation (of 95.55% to 96.50%) during and after the offer; however, also within the normal range for PTNBs[30]. Other studies refer stability of oxygen saturation, respiratory rate and heart rate when compared to the body with a bottle[10,15,16]. Another study obtained saturation lower than 85% for premature fed with cup and considers that this drop is related to the higher effort in the attempt of obtain the food of the cup[27].

It is essential to remember that the independent subsystem is related to the vital functions and must receive attention. Among the several parameters, such as breathing, heart rate, skin color, and others, there is the oxygen saturation, that reflects the baby's stability[6].

Finally, as for the heart rate, there was a difference for the two methods between two specific moments: before/during and before/after (Figure 5). That is, there was an increase of the heart rate when compared with the value of rest previous to the food offer. A previous study, performed with 56 PTNBs of 34 weeks gestational age, showed increase of heart and respiratory rates for cups and bottle when compared to these parameters values before the offer[10]. This can be justified by the fact that the circulatory system regulation is not well developed yet and because the increased heart rate helps to supply more oxygen to the body[29]. It can't be denied that there a physical effort at the time of feeding and that such effort may lead the baby to this variation[27].

The initial hypothesis of the present study partially was confirmed ahead of the obtained results, therefore the use of the syringe was evidenced to cause spillage of the diet. However, it is an inefficient strategy for feeding PTNBs. However, in virtue of the evaluation to have occurred a single time in one day, it is not possible to affirm that the results would be different in case of continuous evaluations carried through. Moreover, the PTNBs already were being orally fed, and were submitted to speech therapy.

An important limitation for the present study was the use of 20 mL syringe, which probably reflects a higher milk flow and may have affected the obtained values, especially for spillage. Therefore, this study results are only valid for the same caliber syringe, and it is not possible to use them for any other syringe size.

Furthermore, even though this research has analyzed both forms of diet offer to the PTNB, it would be of interest to compare other tools, such as cup and bottle, which are normally used in newborn units.

We also suggest that studies involve FFM and its impact to breastfeeding, as this is a method used by speech therapists in newborn services and that does not involve the mother in the suction stimuli when transitioning the feeding method. Furthermore, it cannot be affirmed if the finger introduction with the probe in the newborn oral cavity may affect the ideal movements for feeding.

Thus, it is essential to perform studies with tools, instruments or methods that can facilitate these children feeding and, consequently, result in lower occurrence of stress, higher weight gain and stimuli to breastfeeding.

CONCLUSION

According to the used method, it was verified that the FFM offers a smaller spillage of diet when compared to 20 mL syringe. The oxygen saturation variation and the heart rate observed before, during and after were within the normal limits for both offer methods.

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Author contributions

VCA was responsible for the project elaboration, stablishing the study design and ensure commitment with the execution steps and manuscript writing; ACMM and MARP were responsible for data collection and organization; ACBB was responsible for orienting the study, study design and execution steps and manuscript writing.