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ORIGINAL ARTICLE

Assessment of Oral Feeding Readiness in Preterm Infant by using Preterm Oral Feeding Readiness Assessment Scale (POFRAS)

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Abstract

Background: ***Because of the disorganized behavioral state, metabolic instability, and developmental immaturity, assessment of the ability to initiate oral feeding in cases of preterm infants in the neonatal intensive care unit (NICU) is complex and diverse. So, neonatologists need a validated instrument that permits identifying the weaknesses and strengths of preterm infants who are in the process of transitioning from gastric to oral feeding.***

Objective: ***The aim was to measure the validity and reliability of the preterm oral feeding readiness assessment scale (POFRAS) and to evaluate readiness of preterm infants to start oral feeding safely by using POFRAS.***

Methods: ***This cross-sectional, observational study was carried out on 100 preterm newborns, aged between 30 and 36 weeks at birth, who were hospitalized in the pediatric department's neonatal critical care unit at Al-Zahraa University Hospital.***

Results: ***The studied cases were 100 with a male-to-female ratio of 1:1.The intra-rater reliability of the total POFRAS score was good with intra-class correlation coefficient (ICC) = 0.99 (p <value 0.001), 95% CI (0.98- 0.99). The inter-rater reliability of the total POFRAS score was good with intra-class correlation coefficient (ICC) = 0.81 (p <value 0.001), 95% CI (0.78- 0.87). The best cut-off score value based on the "Youden index" from the receiver operating characteristics analysis (ROC curve) was 29.***

Conclusion: ***This study demonstrated that; POFRAS scale show good reliability and validity and could assist a neonatologist to decide the safe and best time for initiation of oral feeding thus reducing the length of hospital stay.***

Keywords: Preterm infant, breastfeeding, POFRAS

1. Introduction

Due to its well-established health benefits for both moms and infants. It is generally agreed that human milk is the optimal formula for all neonates. Preterm newborns benefit most from human milk since it protects against a number of comorbidities, such as necrotizing enterocolitis, infection (late-onset sepsis), chronic lung disease, and enhanced neurodevelopment.[1]

Prior to starting to breastfeed or use a bottle, hospitalized preterm infants in the NICU may endure weeks or months of endotracheal intubation, stomach tube placements, nasopharyngeal suctioning, and other unpleasant oropharyngeal stimulation.[2,3]

Furthermore, the development of the infant's brain may be impacted by clinical factors such as lung conditions, gastroesophageal reflux, and environmental factors like noise and mother separation. Preterm infants' ability to safely begin oral feeding is believed to be affected by these early abnormal circumstances, which are also thought to alter behavior, the development of sucking and swallowing, and their coordination with breathing.[4]

Oral feeding is challenging for premature infant as they have immature sucking and swallowing mechanisms, inadequate aero digestive reflexes that are needed to prevent reflux and protect their airways, and often have immature esophageal motility.[5]

Early oral feeding intervention in a preterm infant without comprehensive evaluation for oral feeding readiness will lead to serious complications as well, and late feeding trial can delay the reunion of the mother and her infant and hospital discharge; this, in turn, will elevate the stress of mothers and the hospital cost.[6]

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It is challenging from a clinical standpoint to determine when a stable infant is ready for oral feeding. Bedside, the assessment is focused on discrete variables, including weight, gestational age, postmenstrual age, and planned feeding schedules that emphasize the amount of milk the baby receives. [7]

For neonatologists, determining when it is most convenient and safe to start oral feeding preterm infants may be challenging in most NICUs. A standardized instrument must be created in order to assist medical practitioners in determining if premature infants are ready to replace gastric feeding with oral feeding and to promote breastfeeding in neonatal units.[8]

Once a baby is weaned off tube feeding, knowing when to start oral feeding at the right moment might help them feel satisfied with the process. Furthermore, it shortens hospital stays, lowers the time it takes to achieve full oral feeding, and lowers the financial burden on families and the government. Additionally, a precise assessment aids the neonatologist in determining the measures required to assist the newborn in achieving full oral feeding. [9]

One tool that may be used quickly and readily in a clinical setting is the Preterm Oral Feeding Readiness Assessment Scale (POFRAS). It can be stored in a matter of minutes and without causing harm to newborns, which helps neonatologists in their clinical assessments. [8]

This research aims to measure the reliability and validity of the POFRAS and to assess if preterm infants are ready to begin oral breastfeeding in a safe manner.

2. Patients and methods

Our study was a cross-sectional, observational, hospital-based study that enrolled 100 preterm infants between the ages of 30 and 36 weeks gestation. These infants were admitted to the pediatric department's neonatal critical care unit at Al-Zahraa University Hospital in Cairo, Egypt, between November 2022 and December 2023, following approval by the medical faculty's ethical committee at AL-Azhar University.

Inclusion criteria:

A clinically stable preterm infant with age from 30-36weeks gestation, who could not be fed orally with A minute APGAR score of seven or more, birth weight appropriate for gestational age and maternal inclusion (expressed intention to breastfeed upon admission), informed consent was taken from all mothers.

Exclusion criteria:

We excluded preterm infants with severe neurological disorders, congenital anomalies (cleft lip and palate), abdominal pathology (necrotizing enterocolitis), or surgically corrected abdominal pathology, and preterm infants who had undergone major surgery. Maternal exclusion (maternal illicit drug or tobacco, a psychiatric illness, Maternal deafness).

Methods

A structured questionnaire containing:

An interview questionnaire with mothers: to collect the following data: Perinatal history, maternal age, parity, occupation, and socioeconomic state). Medical history (DM, HTN, use of any immune suppressive medication). Mode of delivery. APGAR score at 5 minutes. Assessment of gestational age by Ballard score.[10] Anthropometric measurements (weight, length, head circumference) and main diagnosis. General examination and vital data (heart and respiratory rates, saturation of oxygen, temperature, systolic and diastolic blood pressure). Systemic examination.

Laboratory and Radiological Investigation.

POFRAS Instrument:

Fujinaga et al. created POFRAS.[11] This 18-item observational checklist is designed to assess preterm infant suitability for nursing. It comprises five groups: oral posture, reflexes, non-nutritive sucking, behavioral organization, and corrected gestational age. The POFRAS has a total score range of zero to 36, with each item having a value between 0 and 2.

Collection of data

The data were collected by researcher and mothers who were the observers. The preterm infant were assessed using POFRAS 15 minute prior feeding time. Physiologic monitoring are continued during breast feeding session depending on apnea, bradycardia and desaturation.

To examine the inter-rater reliability: After recruitment, the infant was positioned in a lateral decubitus position in an incubator by the researcher. Then, through gentle tactile touching or calling, the infant was awakened; the observation was done by the researcher and mothers to fulfill the item scale.

The newborn was fed by the researcher using the finger feeding technique after both observers completed their scores on the scale. For premature infants, finger feeding offers a temporary substitute for traditional feeding techniques.[12] If the preterm newborn is not sucking within five minutes or has signs (such as apnea, bradycardia, coughing, desaturation, skin color change, nasal flaring, or hiccups) that jeopardize their stability, oral feeding should be discontinued. [13]

To examine the intra-rater reliability:During the first assessment, the researcher checked each infant and recorded the behaviors on video. One week later, this researcher observed the recorded video and scored the infant's oral performance again.

Statistical analysis

Recorded data were analyzed using the SPSS

software program. Qualitative variables were represented in number (%), while quantitative variables were described as mean (±SD). The inter-rater and intra-rater reliabilities of the POFRAS scale were determined by Intra-class Correlation Coefficients (ICC) based on the overall score. The coefficient <0.5 indicates poor reliability; the coefficient of 0.51-0.75 refers to moderate reliability, and the coefficient >0.75 refers to good reliability.[14]

Both inter-rater and intra-rater agreement for scale items: Weighted kappa was utilized to analyze ordinal data; a Kappa score of ≥0.75 indicates extremely good agreement, 0.40-0.75 indicates fair agreement, and <0.40 indicates poor agreement.[15] For criterion validity, the cut-off score of the POFRAS was compared with global accuracy, sensitivity, and specificity using the gold standard, the receiver operating characteristics (ROC) curve. The significance threshold was set at p-value < 0.05, and the data were shown in tables and graphs. Pearson's correlation coefficient (r)was used for the measurement of the correlation strength between two continuous factors.

3. Results

Section I;

Table 1. Demographics of studied infants:

Descriptive characteristics		Mean ± SD	Min. - Max.
Gestational age (weeks)		34.60 ± 1.78	30 – 36
Postnatal age (days)		4.10 ± 2.69	1 – 16
Birth weight (kg)		2.15 ± .57	1-3.2
Current weight (kg)		2.12 ± .60	1 – 3.2
Corrected gestational age(CGA) (weeks)		35.05 ± 1.68	30.3 – 37.1
		Number	Percentage (%)
CGA	≤ 32 weeks	7	7
	Between 32-34 weeks	11	11
	≥ 34 weeks	82	82
Gender	Male	50	50
	Female	50	50
Problem at birth	RD	93	93
	RD/IDM	4	4
	IDM	2	2
	Neonatal jaundice	1	1

Max: Maximum, Min: Minimum, SD: Standard deviation, RD: Respiratory distress, IDM: Infant of diabetic mother, kg: kilogram

This table illustrates that 50% of the included infants were female. Regarding birth issues, 93% had respiratory distress (RD), 4% were infant of diabetic mother (IDM) + respiratory distress, 2% were infant of diabetic mother and 1% had jaundice. The mean gestational age and corrected gestational age was 34.60 (± 1.78) weeks, and 35.05 (± 1.68) weeks, respectively. The mean postnatal age of infants was 4.10 (± 2.69) days, their mean birth weight were 2.15 (± 0.57) kg and their mean current weight were 2.12 (± 0.60) kg.

Section II: Scale Accuracy

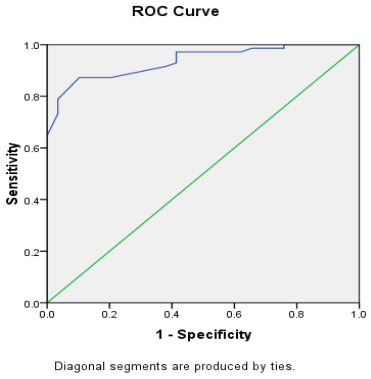

Figure 1. ROC of total Score of POFRAS for the 1st Observer. Area Under the Curve (AUC) =0.936 (95% (CI) = (0.89-0.981)

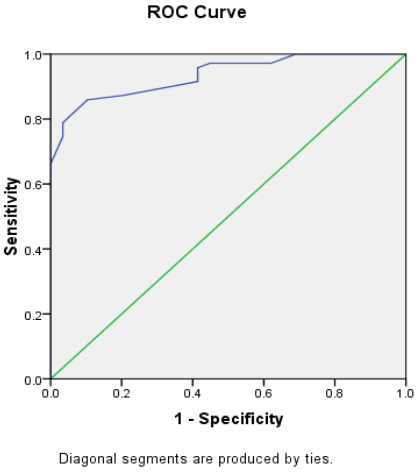

Figure 2. ROC of total Score of POFRAS for the 2nd Observer. Area Under the Curve (AUC) = 0.935 (95% CI = 0.890-0.980)

Table 2. Observers' values of Youden index and Kappa coefficient.

Cut-off score at 29	Sensitivity	Specificity	KappaCoefficient	P value
Observer1	0.87	0.90	0.8499	0.000*
Observer2	0.86	0.90		

This table illustrates the best cut-off value based on "Youden index" from the ROC analysis. It was recorded from the receiver operating characteristics analysis (ROC curve) to be 29. For the 1st observer, 0.87 and 0.90 sensitivity and specificity, respectively were found at a cut-off value of 29, while for the 2nd observer, 0.86 sensitivity and 0.90 specificity were found. When the two observers were grouped based on their cut-off scores, the inter-rater agreement was flawless (Kappa=0.849; p=0.000). The inter-rater percent agreement was 93% (in 93 preterm).

Section III: Reliability of POFRAS scale

Table 3. The Intra-Rater Reliability of POFRAS

	Scale Item	Kappa Coefficient	Qualitative Assessment
1	Corrected gestational age	0.89	VG
2	Behavioral state	0.88	VG
3	Global posture	0.79	VG

4	Global tonus	0.80	VG
5	Lip posture	0.89	VG
6	Tongue posture	0.86	VG
7	Rooting reflex	0.90	VG
8	Sucking reflex	1.00	VG
9	Biting reflex	0.73	Fair
10	Gag reflex	0.96	VG
11	Tongue movement	1.00	VG
12	Tongue cupping	0.93	VG
13	Jaw movement	0.95	VG
14	Sucking strain	0.90	VG
15	Sucking and pause	0.87	VG
16	Sucking/pause Maintenance	0.88	VG
17	Alert state Maintenance	0.92	VG
18	Stress sign	0. 74	Fair

VG; Very good

This table displays the results of intra-rater reliabilities of POFRA Scale for each item as measured by weighted kappa. It was found that 16 items were very good (88.9%) and 2 items (10.1%) measured as fair.

Table 4. The Inter-Rater Reliability of POFRA Scale.

	Scale Item	Kappa Coefficient	Qualitative Assessment
1	Corrected gestational age	0.87	VG
2	Behavioral state	0.89	VG
3	Global posture	0.77	VG
4	Global tune	0.73	VG
5	Lip posture	0.68	Fair
6	Tongue posture	0.81	VG
7	Rooting reflex	0.85	VG
8	Sucking reflex	0.90	VG
9	Biting reflex	0.74	Fair
10	Gag reflex	0.92	VG
11	Tongue movement	0.89	VG
12	Tongue cupping	0.77	VG
13	Sucking and pause	0.89	VG
14	Sucking strain	0.87	VG
15	Jaw movement	0.89	VG
16	Sucking/pause Maintenance	0.77	VG
17	Alert state Maintenance	0.89	VG
18	Stress sign	0.69	Fair

VG; Very good

This table displays the results of intra-rater reliabilities of POFRA Scale for each item as measured by weighted kappa. It was found that 15 items of this scale were very good (83.3%) and 3 items (16.7%) measured as fair.

Table 5. Intra-rater reliability and inter-rater reliability of the total scores of POFRAS.

	Mean± SD	ICC	95% Confidence Interval	P value
POFRAS Total score	29.63± 6.88	0.99	0.98- 0.99	0.000*
POFRA Total score	29.01±2.01	0.81	0.78-0.87	0.000*

This table shows the intra-rater reliability of the total POFRAS scale score. The reliability was good with ICC = 0.99 (p < 0.001), 95% CI (0.98- 0.99).

The inter-rater reliability the total POFRAS scale score. There was a good reliability with ICC = 0.81 (p < 0.001), 95% CI (0.78- 0.87).

Table 6. Categories of preterm infants regarding the findings obtained with both POFRAS and the 5 ml standard:

	5 ml standard		
POFRAS	Non-oral feeding n (%)	Oral feeding n (%)	
Non-oral feeding	27 (90.0)	9 (12.8)	36 (100)
Oral feeding	3 (10.0)	61 (87.2)	64 (100)
Total	30 (100)	70 (100)	100

This table shows that the sensitivity of both POFRAS was 87.2% (61/70) and the specificity was 90.0% (27/30). In general, 88% (n= 88) of the infants (n= 100) were presented the same decision by both POFRAS scale and 5 ML gold standard.

Section IV: Correlation

Table 7. Correlation between total POFRA Score with gestational age, birth weight, duration of oxygen supply and days spent to achieve independent oral feeding:

Total POFRAS score with	Correlation coefficient (r)	P value
Gestational age (weeks)	0.556	.000*
Birth weight (kg)	0.479	.000*
Duration of oxygen supply	-0.596	.000*
Days to achieve independent oral feeding	-0.891	.000*

Table 7: illustrates the positive moderate significant correlation of total POFRA Score with both gestational age and birth weight, negative moderate significant correlation with duration of oxygen supply, negative very strong significant correlation with days spent to achieve independent oral feeding.

4. Discussion

Oral feeding is challenging for premature infant as they have immature sucking and swallowing mechanisms, inadequate aero digestive reflexes needed to prevent reflux and protect their airways, and often have immature esophageal motility.[5]

The POFRA scale is an easy, rapid instrument that can be used in clinical practice as scoring consumes a few minutes with no harm for infants to help neonatologists in their clinical assessment. Also, it is the only scale that assesses all oral-motor skill aspects among preterm infants before feeding time, including maturity, behavioral organization, state of consciousness, oral motor and motor skills, and neural and sucking progression. [9]

Regarding the gender; this research results demonstrated that, half of the infants were males. This finding in the same line with Alonso-Fernández et al.,[16] who reported that about half of

the infant were males.

Regarding the intra-rater reliabilities of the POFRA Scale for each item as measured by weighted kappa, it was found that 16 items of this scale were very good (88.9%) and two items (biting and stress signs) (10.1%) measured as fair with intra-class correlation coefficient (ICC) = 0.99 ($p < 0.001$), 95% CI (0.98- 0.99). This results supported that of Kamran et al.[9] who reported the intra-rater reliability to be an excellent and good agreement for 8 (26.6%) and 5 (20%) items, respectively, and unsatisfactory agreement for two items (lip posture, stress sign) representing (6.6%) with ICC: 0.97; 95% CI: 0.94-0.98).

Regarding inter-rater reliabilities of the POFRA Scale for each item as measured by weighted kappa, The current study showed a very good agreement for 15 items of this scale (83.3%) while three items (16.7%), including (lip posture, biting reflex, and stress signs) measured as fair with intra-class correlation coefficient (ICC) = 0.81 ($p < 0.001$), 95% CI (0.78- 0.87). This results were in the same line with the results of Çamur and Çetinkaya[17] who reported the inter-rater kappa coefficient of agreement to be 0.93 and showed a very good agreement for the majority of scale items (82.3%) and three items including (biting reflex, sucking and pause and stress signs) measured as fair.

Kamran et al.[9] Çamur and Çetinkaya[17], and Fuginaga et al.[18] were in the same line with our study regarding low levels of inter-rater agreement for stress signs. This might be related to behavioral state and state of alertness that affect an infant's clinical stability. The infant's manipulation is the reason to change the infant's stability.[18]

The biting reflex refers to jaw clenching, then relaxing in response to the stimulus of the gingival line in the oral cavity by the finger of the examiner. The current study reported fair inter-rater reliability in biting reflex, which was in the same line with Çamur and Çetinkaya[17], while Kamran et al.[9] demonstrated excellent inter-rater reliability regarding such reflex. This might be related to the difficulty of measurement as POFRAS assessment is a subjective method, depending on the observer's experience and exact observation, especially for the biting reflex, as it depends on tactile sensitivity.

According to the correlation between the preterm infant's total POFRAS score and their gestational age and birth weight, the current study revealed a statistically significant positive correlation between the infant's total POFRA Score and their corrected birth weight and age. This finding was supported by Fujinaga et al.[11], Lubbe[19], and Foster et al.[20] This might be related to the fact that oral feeding readiness was affected by many factors, including corrected gestational age and birth weight so that infants' corrected gestational age was included in the POFRA Scale.

Moreover, regarding the correlation between the preterm infant's total POFRAS score and the duration of oxygen support and days spent to achieve independent oral feeding, this research revealed a very strong, significant negative correlation between the infant's total POFRAS score and duration of oxygen supply and days spent to achieve independent oral feeding. This finding might be related to clinical instability and respiratory, cardiac, and metabolic problems that may necessitate prolonged oxygen therapy and affect the suitability of preterm infants for nursing, in addition to the delay in independent oral feeding achievement.

4. Conclusion

The current study demonstrated that most items of the Preterm Oral Feeding Readiness Assessment Scale displayed very good inter-rater and intra-rater reliabilities with good inter-rater and intra-rater reliability of the total readiness score of preterm oral feeding. Also concluded a significant positive correlation between infant's total POFRA Score and their corrected gestational age and birth weight. POFRAS could aid the neonatologist working in the NICU in determining the best and safest time for switching from tube to oral feeding.

Disclosure

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Authorship

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Conflicts of interest

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