Research Paper: The Interrater and Intrarater Reliability of the Preterm Infant Oral Feeding Readiness Assessment Scale

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ABSTRACT

Introduction: One of the most challenging decisions is to assess the preterm infant's transition from tube feeding to oral feeding. Thus, we require a reliable tool for determining the time to start oral feeding. This study aimed to measure the interrater and intrarater reliability of the Preterm Infant Oral Feeding Readiness Assessment scale (PIOFRA).

Materials and Methods: This study was an observational, cross-sectional study. The study participants were preterm infants who had been hospitalized in the Neonatal Intensive Care Unit of Shariati Hospital affiliated to Tehran University of Medical Sciences, between December 2017 and February 2018. The inclusion criteria were absence of neurological and gastrointestinal disorders or major congenital anomalies, Apgar score 3 or more in the first 1 minute, and 5 or more in the first 5 minutes. The exclusion criteria included family's unwillingness to participate in the study, infant's death, or a sudden change that affects neonates' nutritional status, like cerebral hemorrhage or intestinal problems.

Results: The interrater and intrarater reliability of the total PIOFRA scale was good Intraclass Correlation Coefficients (ICC>0.75). The interrater and intrarater reliability of most items were good and excellent, with weighted kappa more than 0.50, with the exception of lip posture and especially stress sign, with weighted kappa less than 0.40.

Conclusion: Generally, most items of the PIOFRA scale had acceptable interrater and intrarater reliability. Also, the interrater and intrarater reliabilities of the total POFRAs score was good.

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1. Introduction

Achieving an efficient feeding skill is one of the biggest challenges of preterm infants [1]. The integration of maturation, physiological stability, behavioral state organization, and coordinated sucking-swallowing-breathing are prerequisites of successful feeding. In other words, successful feeding indicates neurobehavioral maturation. Furthermore, it is a prerequisite of sufficient oral nutrient intake [2].

The majority of healthy full-term infants experience safe oral feeding because they can coordinate sucking, swallowing, and breathing. However, preterm infants do not show these maturities, and they will achieve these skills gradually [1]. Therefore, preterm infants, before achieving independent oral feeding need a period of enteral feeding. One of the most challenging decisions is to when stop tube feeding and start oral feeding. Besides physiological stability and consistent weight gain, this independent oral feeding is another factor necessary for the baby before discharge from the hospital.

Delays in discharge increase financial costs on the families and government [1, 3]. One of the objectives of the speech-language pathologist is to facilitate the transition to independent oral feeding [4]. Accordingly, care services focus not only on survival of preterm infants but also on comprehensive, humanized, and preventive care, within an individualized and developmental care perspective, which requires training the neonatal care team [5].

Clinically, recognizing the exact time to start oral feeding in stable infants is difficult. Besides, the evaluation is based on isolated factors such as gestational age, postmenstrual age, weight, and scheduled feeding regimens that focus on the volume of milk that consumes the infant [3]. The majority of health professionals, in this process, consider isolated data for the infants, without assessing oral motor skills, general conditions, and neuro-psycho-motor development [4, 5]. These parameters for safely initiating oral feeding are not sufficient [4].

Several scales are available for clinicians to evaluate the infant's feeding skills [6]. Some tools of infant's feeding skills assessment such as LATCH (L: Latches; A: Audible swallowing; T: Nipple type; C: Level of comfort; H: Holding infant) were developed for infants who are fed from the breast [7]. The early feeding skills assessment for preterm infants, the support of oral feeding for fragile infants, and the infant driven feeding assessment were designed for infants who started oral feeding [8-10].

Neonatal Oral Motor Assessment Scale (NOMAS) is one of the earliest tools that assesses an infant's oral motor function and sucking. The NOMAS is a 28-item assessment tool that evaluates the infant's jaw and tongue movements and classifies an infant's sucking patterns as normal, disorganized, or dysfunctional. The NOMAS is used from birth through eight weeks' corrected age. However, it only assesses the movements of the tongue and jaw [11, 12]. Thus, clinicians need a tool to measure all aspects of oral skills and to gain the necessary information whether the infant needs intervention before initiation of oral feeding.

The only tool that assesses all dimensions of oral-motor skills in preterm infants before feeding and, more importantly, helps to recognize oral-motor problems of infants before the start of oral feeding is Preterm Infant Oral Feeding Readiness Assessment scale (PIOFRA). The PIOFRA scale is used to assess preterm infant oral feeding readiness. It was designed by Fujinaga et al. in Brazil. The aspects of this scale includes corrected age, behavioral organization (behavioral state, global posture, and tonus), oral posture (lips and tongue), oral reflexes (rooting, sucking, biting, and gag) and nonnutritive sucking (tongue movement, tongue cupping, jaw movement, sucking strain, sucking and pause, maintenance of rhythm of sucking and pause, maintenance of state of alertness and stress signs). A score ranging from 0 to 2 was attributed to each item of the protocol. The performance of the infant is determined by the sum of the scores obtained, which can vary from 0 to 36. The validity and reliability of this scale were determined in 2007 and 2013. The scale has a sensitivity of 60% and a 75% specificity [4, 5, 12, 13].

Accordingly, the assessment of nonnutritive sucking with other dimensions of the infant's global behavior, such as gestational age, posture, and global tonus and behavioral state, are among signs which demonstrate maturity for the transition to oral feeding [5].

Therefore, it would be helpful to use a reliable scale that provides useful clinical guidelines for speech-language pathologists to assess infant's oral feeding readiness skills comprehensively. Because there is not a reliable scale to assess preterm infant oral feeding readiness in speech therapy clinics in Iran and no research has ever tested the reliability of the PIOFRA scale in Iran, we aimed to measure the interrater and intrarater reliability of this scale.

2. Materials and Methods

This study was an observational, cross-sectional study conducted on preterm infants 34 weeks old or younger who had been hospitalized in the Neonatal Intensive Care Unit of Shariati Hospital affiliated to Tehran University of Medical Sciences, between December 2017 and February 2018.

The infants' parents gave their consent before the study. The study objectives were written in the consent forms. Moreover, some points were explained to all infant's parents. Preterm infants that had clinical stability were entered in the sampling that was the convenience sampling method.

The sample consisted of 30 preterm infants; 17 females and 13 males. Their Mean±SD gestational age was 223.96±11.73 days. Their Mean±SD weight at birth was 1642±320.54 g About 90% of the samples experienced respiratory problems at birth. Table 1 presents the clinical data for infants of this research. The inclusion criteria were infants who lacked any neurological and gastrointestinal disorders or major congenital anoma-

Table 1. The infants' clinical data

Infants	Gestational Age (d)	Birth Weight (g)	Sex (Female: 1, Male: 2)	1-Min Apgar Score	5-Min Apgar Score	Problems at Birth
1	230	1705	2	8	9	Respiratory discomfort
2	210	1370	1	5	8	Respiratory discomfort
3	224	1930	2	4	7	Respiratory discomfort
4	212	1650	1	3	8	Respiratory discomfort
5	237	1710	1	5	8	Respiratory discomfort
6	238	1630	2	4	6	Respiratory discomfort
7	238	1790	2	8	9	Respiratory discomfort
8	238	2290	2	8	9	None
9	226	1460	1	8	9	Respiratory discomfort
10	210	1960	1	8	9	Respiratory discomfort
11	231	1935	1	7	8	Respiratory discomfort
12	224	1170	2	8	9	Respiratory discomfort
13	238	2110	1	8	9	None
14	216	1670	1	3	8	Respiratory discomfort
15	224	1375	1	8	9	Respiratory discomfort
16	219	1500	1	7	9	Respiratory discomfort
17	231	2060	2	8	10	Respiratory discomfort
18	224	1810	1	8	9	Respiratory discomfort
19	224	1170	2	8	9	Respiratory discomfort
20	238	1205	1	4	8	Respiratory discomfort
21	217	1605	2	7	9	Respiratory discomfort
22	211	1730	2	3	8	Respiratory discomfort
23	210	1400	1	5	8	Respiratory discomfort
24	223	1905	1	6	7	Respiratory discomfort
25	196	1000	2	4	7	Respiratory discomfort
26	238	1330	1	8	9	Respiratory discomfort
27	230	1810	2	8	9	Respiratory discomfort
28	238	2110	1	6	8	None
29	221	1540	2	8	9	Respiratory discomfort
30	203	1330	1	4	6	Respiratory discomfort

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lies, and their Apgar score was three or more in the first minute and five or more in the first five minutes of birth. The exclusion criteria included family's unwillingness to participate in the study, infant's death, or a sudden change that affects neonates' nutritional status, like cerebral hemorrhage or intestinal problems.

To test the interrater reliability of the scale, two speech-language pathologists assessed each infant 15 minutes before their feeding time. The observers had no verbal contact. Therapists accomplished the assessment concurrently for each infant, and they did not talk to each other. The first therapist awakened the infant using the tactile, visual, and auditory stimuli. This therapist handled the infant to assess the behavioral organization, oral posture, and presence of oral rooting and vomiting reflexes. Both therapists noticed these behaviors concurrently. Each of therapists evaluated the biting and sucking reflexes and nonnutritive sucking (during one minute) separately by the gloved pinkie.

To examine intrarater reliability, one of the therapists once assessed each infant and recorded the infant's behaviors on video during the first assessment. After one week, this therapist observed the video that was recorded during the first assessment and scored the infant's oral performance again.

Statistical analysis

All data were analyzed in SPSS V. 23 The interrater and intrarater reliabilities of the PIOFRA scale were determined by Intraclass Correlation Coefficients (ICC) based on the total score. The coefficient less than 0.5 indicates poor reliability; the coefficient between 0.51 and 0.75 represents moderate reliability, and the coefficient greater than 0.75 represents good reliability [14]. Both interrater and intrarater agreement for ordinal scaled data were examined by weighted kappa. Evaluation criteria for kappa, using guidelines described in Cicchetti and Sparrow (1981) and Fleiss (1981) were as follows: Fair: 0.40 to 0.59; Good: 0.60 to 0.74; and Excellent: >0.74 [15, 16].

3. Results

Tables 2 and 3 present the results of the weighted kappa for each item. The interrater reliability demonstrated excellent agreement for 9 (30%) items, good for 6 (20%) items, fair for 1 (3.3%) item, and unsatisfactory agreement for 1 (3.3%) item (Table 2). The intrarater reliability indicated excellent agreement for 8 (26.6%) items,

good for 5 (20%) items, fair for 2 (3.3%) items, and unsatisfactory agreement for 2 (6.6%) items (Table 3).

The ICC and Standard Error of Measurement (SEM) of total Preterm Infant Oral Feeding Readiness Assessment (PIOFRA) scale score are presented in Tables 4 and 5. The interrater reliability of the total PIOFRA scale score was good (ICC: 0.84; 95% CI: 0.66-0.92) (Table 4). The intrarater reliability of the total PIORAF scale score was good, too (ICC: 0.97; 95% CI: 0.94-0.98) (Table 5).

4. Discussion

The majority of the protocols of preterm infant feeding assessment are designed to determine the exact time for starting oral feeding [17]. The recognition of the best time for initiating oral feeding help infant to experience satisfaction from oral feeding after being wean from tube feeding [18]. Furthermore, it contributes to reducing the duration of achieving full oral feeding, decreasing the length of hospitalization, and the financial costs for the family and government [1, 2]. Moreover, an exact assessment helps the therapists to determine what interventions infant needs for achieving full oral feeding [19].

PIOFRA scale is one of the instruments that can be used easily, quickly, and without any harm, for infants to help speech-language pathologists in their clinical assessments. Also, the scale considers the variety of dimensions such as level of maturity, behavioral organization, state of consciousness, and oral-motor skills [5, 13]. This study aimed to investigate interrater and intrarater reliabilities of the PIOFRA scale. The results of this study demonstrated that the interrater and intrarater reliabilities of most items of this scale were good and excellent, with weighted kappa more than 0.60. However, lip posture, tongue posture, and especially stress sign were exception, because their weighted kappa was less than 0.52. Also, the interrater and intrarater reliabilities of the total PIOFRA scale score was good, with ICC greater than 0.75.

There is not any research that tests the reliability of the PIOFRA scale except the Fujinaga et al. study. The results of their study demonstrated that the interrater reliability of the majority of the items were excellent and good except tongue cupping, maintenance of sucking, and stress sign [5]. Stress sign was the only unsatisfactory item that was the same between Fujinaga et al. and our study. One of the reasons for the low level of interobserver agreement is the alteration of infant's clinical

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Table 2. The interrater reliability of PIOFRA scale for each item

Scale Item	Kappa	Qualitative Assessment
Behavioral state	0.84	Excellent
Global posture	0.63	Good
Global tune	1.00	Excellent
Lip posture	0.50	Fair
Tongue posture	0.76	Excellent
Rooting reflex	0.64	Good
Sucking reflex	0.78	Excellent
Biting reflex	0.82	Excellent
Gag reflex	0.71	Good
Tongue movement	0.62	Good
Tongue cupping	0.73	Good
Jaw movement	0.68	Good
Sucking strain	0.84	Excellent
Sucking and pause	0.85	Excellent
Maintenance of sucking/pause	0.77	Excellent
Maintenance of alert state	0.95	Excellent
Stress sign	0.35	Unsatisfactory

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Table 3. The intrarater reliability of PIOFRA scale for each item

Scale Item	Kappa	Qualitative Assessment
Behavioral state	0.90	Excellent
Global posture	0.68	Good
Global tune	0.72	Good
Lip posture	0.38	Unsatisfactory
Tongue posture	0.51	Fair
Rooting reflex	0.74	Good
Sucking reflex	0.90	Excellent
Biting reflex	0.65	Good
Gag reflex	0.67	Good
Tongue movement	0.89	Excellent
Tongue cupping	0.60	Good
Jaw movement	0.84	Excellent
Sucking strain	0.90	Excellent
Sucking and pause	0.88	Excellent
Maintenance of sucking/pause	0.94	Excellent
Maintenance of alert state	0.95	Excellent
Stress sign	0.09	Unsatisfactory

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Table 4. The interrater reliability of the total PIOFRA scale score

Total Score	Mean±SD	ICC	95% CI	SEM
PIOFRA scale	19.56±7.74	0.84	0.66-0.92	3.09

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Table 5. The intrarater reliability of the total PIOFRAscore

Total Score	Mean±SD	ICC	95% CI	SEM
PIOFRA scale	20.70±7.941	0.97	0.94-0.98	1.35

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stability. Infant's manipulation is the reason to change infant's stability [20, 21].

Infant's lip posture and tongue posture in every infant is different in various states [21]. Fujinaga et al. indicated a high level of interobserver agreement while our research demonstrated lower level of agreement, especially in lip posture compared to that in the study by Fujinaga and associates. This difference is probably because of using observers with different experiences and precision in each study. The weighted kappa of the behavioral state, global posture, gag reflex, and maintenance of alert state in interrater and intrarater reliabilities of the present research was nearly similar to Fujinaga et al. study findings.

Tongue cupping refers to when sides of the tongue elevate, and a groove is created in the middle of the tongue, and the number of sucks and pause refers to maintenance of sucking and pause rhythm [5, 22]. There is a significant difference in the tongue cupping and maintenance of sucking items between the findings of Fujinaga et al. study and our research. Although the interrater reliability of these items in our study was good and excellent, in the study of Fujinaga et al., they were unsatisfactory. These differences may be due to the difficulty of measurements because the assessment of the PIOFRA scale is subjective and both items rely on tactile sensitivity and exact observation. Moreover, the infant's behavioral state may influence sucking patterns [21].

The reliability finding of this research and results of Bolzan et al. study illustrated that the accuracy of the PIOFRA scale is moderate; however, the concordance the oral feeding skill level and the PIOFRA scale was weak; thus, another assessment tool should be used besides PIOFRA scale in clinical assessments [4].

One of the biggest problems of the PIOFRA scale is the evaluation of oral function subjectively. Therefore, it is necessary to study the reliability of this scale in comparison with an objective examination, for instance, ultrasound imaging and electromyography. Using objective methods, muscular activity can be observed during nonnutritive sucking, for example, tongue elevation during nonnutritive sucking and also tongue and hyoid movements during nutritive sucking are observable by ultrasound imaging [23, 24].

5. Conclusion

Generally, most items of the PIOFRA scale demonstrated excellent and good interrater and intrarater reliabilities, except for stress sign and lip posture. Also, the interrater and intrarater reliabilities of the total PIOFRA scale score was good. We suggest that the next studies examine the reliability of this scale by two professional feeding therapists or the result of the PIOFRA scale be compared with objective examination.

Ethical Considerations

Compliance with ethical guidelines

Funding

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