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Original Article

Developing the Mansoura Early Feeding Skills Assessment Scale for Preterm Infants

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The authors have no financial conflicts of interest.

ABSTRACT

Purpose: This study aimed to develop a new bedside scoring system scale that assesses preterm infants' oral feeding skills (OFS) in the neonatal intensive care unit (NICU).
Methods: A literature review and critical appraisal of available oral feeding assessment tools/scores were performed. Subsequently, we developed the "Mansoura Early Feeding Skills Assessment" (MEFSA) scale, an 85-item observational measure of oral feeding skills with three main sections. Forty-one preterm infants who did not receive oral feeding but were clinically stable enough to initiate oral feeding were included in the study. Next, we applied and interpreted the MEFSA to describe and score their feeding skills.
Results: Applying the MEFSA resulted in a smooth feeding transition, early start of oral feeding, full oral feeding, and discharge with a shorter period of tube feeding in preterm infants.
Conclusion: The MEFSA is a successful bedside scoring system that assesses the OFS of preterm infants in the NICU.

Keywords: Preterm; Infant feeding; Infant development; Enteral nutrition; Neonatal intensive care unit, premature

INTRODUCTION

Preterm infants undergo a period of Ryle feeding before achieving independent full oral feeding (FOF). The ideal time to start oral feeding (SOF) varies among neonatal intensive care units (NICUs) [1]. Increasing evidence shows that a "cue-based" oral feeding approach promotes preterm infants feeding independence and allows infants to learn to feed efficaciously and safely. This cue-based oral feeding approach recognizes the signs of readiness for oral feeding and distress during feeding. The progression of preterm infant oral feeding is mainly based on the level of neurodevelopmental maturity, avoidance of undue stress during feeding, and making the infants' feeding experiences as positive as possible [2,3].

A comprehensive clinical assessment is necessary to develop an individualized, evidence-based management plan for oral motor feeding in infants [4-6]. Accurate evaluation helps identify oral feeding readiness and to make a differential diagnosis of the causes [7].

Furthermore, proper assessment can indicate the therapeutic interventions required to achieve an early FOF [8].

The prevalence of premature births in Egypt is high, from 2.4% in 2011 to 4.7% in 2015, with the highest rate in 2013 (5.3%) [9]. Currently, no data on the prevalence of feeding difficulties in preterm infants are available in Egypt. Unfortunately, no definitive criteria have been established to guide decisions on when and how to progress to oral feeding in preterm infants. There is no specific policy for initiating oral feeding, but it mostly depends on the gestational age (GA) and weight. This supports the need for an appropriate early clinical assessment of oral feeding skills (OFS) in preterm infants in the NICU.

The existing assessment tools may not meet the needs of NICUs in Egypt. This encouraged us to develop a new scoring system for the early feeding skills of preterm infants. The scoring system supports a cue-based oral feeding approach. Consequently, preterm infants could achieve early, safe, and successful oral feeding.

Aim

This study aimed to develop a new bedside scoring system to assess the OFS of preterm infants in the NICU. Subsequently, the impact of applying the evaluation scoring system scale and early individualized support on feeding patterns and the outcomes in premature neonates were evaluated.

MATERIALS AND METHODS

Study design

A descriptive and analytical design was chosen for this study.

Ethical considerations

The study protocol was approved by the Instititutional Review Board, (IRB), faculty of Medicine, Mansoura University (proposal code:MS.19.04.572). The resesearch procedures were conducted following the prinicple of the declaration of Helsinki.

Consent to participate

Informed written consent was obtained from the parents of the preterm infants participating in the study. Parents have the right to withdraw from the study without penality.

Phases of the study

Phase 1: An extensive review of the availableoral feeding assessmenttools/scores in the literature with critical appraisal was performed. Subsequently, an assessment tool was developed, the “Mansoura Early Feeding Skills Assessment” (MEFSA) scale.

Phase 2: Participants were selected. Next, the MEFSA was applied to score the OFS and recommendations could then be drawn. The results were then analyzed.

PHASE 1 was conducted as follows

1. Literature review

The literature was reviewed for the availableneonatal oral feeding assessment tools/scores. A wide variety of protocols is used to assess OFS, ranging from nonstandardized observations

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to standardized assessment tools [10]. Details of the literature review data and critical appraisal of the existing neonatal oral feeding assessment tools/scores are presented in the Results section.

2. Developing the MEFSA scale

We developed a new scoring system for early feeding skills in preterm infants, the "MEFSA" scale (**Appendix 1**).

To develop a valid and reliable tool, the MEFSA was constructed to fulfill the advantages of existing assessment instruments and overcome their limitations as much as possible. Thus, the MEFSA tool can help clinicians incorporate standardized assessments along with clinical observations of oral motor skills. This may prevent the adverse sequelae associated with prolonged tube feeding.

The MEFSA (**Appendix 1**) is an 85-item observational measure of the OFS that follows a cue-based feeding regimen. It includes three main sections: pre-feeding, during feeding, and post-feeding. Moreover, recommendations are provided to support pre-existing feeding skills until the systems are sufficiently mature for oral feeding. In addition, interventions to facilitate OFS acquisition are recommended. Finally, the MEFSA ends with a plan for further follow-up assessments.

The "pre-feeding" section, "Oral Feeding Readiness and OFS," includes 30 items proposed to assess whether the infant is ready to SOF. This supports a growing body of research that defines oral feeding readiness as a complex indicator of an infant's feeding emergence, ability to feed orally, and readiness for any particular feeding event. It depends on five subsystems: (1) autonomic stability, (2) motor organization, (3) behavioral state, (4) attention and interaction, and (5) self-regulation.

Readiness to feed orally based on behavioral measures may not guarantee successful oral feeding. As with nutritive sucking (NS), other aspects are also relevant, particularly suck-swallow-breath (SSB) coordination [11]. Hence, we added an assessment of NS using the neonatal oral-motor assessment scale (NOMAS) and proceeded to the during feeding section.

The "during feeding" section, "Oral Feeding Maintenance," comprises 30 items that allow the infant to communicate and express stress signals. The infant is observed from moment to moment during feeding to assess the infant's ability to remain engaged in feeding, organize oral motor skills, maintain physiological stability, and coordinate SSB. Stress signals were subjectively observed by the attending phoniatrician and objectively measured using data from a vital signs monitor and pulse oximetry.

The "post-feeding" section, "Oral Feeding Tolerance," evaluates the infant's ability to recover and self-regulate after oral feeding. This section has 25 items proposed to assess behavioral and physiological recovery during the 5 minutes following oral feeding. This includes observing the impact on the infant's state, behavioral organization, vital signs, and clinical state.

The "recommendations" section follows the three sections of the MEFSA. It is essential to know that assessments and interventions are incorporated into the functions. Interventions must relate to the features of the observed feeding. Recommendations include feeding route, nipple level, oral motor therapy, and supportive feeding strategies. Oral motor therapy may consist

of oral stimulation, non-nutritive sucking (NNS) stimulation, or both. Supportive strategies include repositioning, pacing, regulation, endurance technique, and jaw and cheek support.

PHASE 2 was conducted as follows

1. The participants were selected

Infants admitted to the NICU of Mansoura University Children's Hospital (MUCH) were subjected to inclusion and exclusion criteria. Preterm infants born at <37 weeks of gestation who had not received oral feeding and who were diagnosed by the attending neonatologist as clinically stable to initiate oral feeding were included in the sample. Infants who presented at the time of the study with at least one of the following conditions were excluded: known congenital or chromosomal disease, cardiac malformation, bronchopulmonary dysplasia, gastrointestinal problems (intestinal obstruction or feeding intolerance), head and neck malformation, intracranial hemorrhage, or a surgical condition.

2. The feeding skills of the premature infants were described and scored using the MEFSA, and then suggestions and recommendations were drawn

The MEFSA sections were scored, and the highest score obtained for every item indicated the best oral feeding performance among the infants, as shown in **Table 1**.

Suggestions could be drawn to provide individualized early oral feeding experiences and recommend appropriate intervention strategies (**Table 2**).

Table 1. MEFSA scoring

Pre-feeding scale (oral feeding readiness & OFS)	
The scale of behavioral organization	7:21
The scale of vital signs (cardiopulmonary stability)	5:15
Scale of reflexive oral motor skills	8:24
The scale of the non-nutritive sucking reflex	0:27
The total score of the pre-feeding scale	20:87
During feeding scale (oral feeding maintenance)	
Maintain engagement in feeding	0:4
Maintain vital signs (cardiopulmonary stability)	0:4
Other clinical difficulties	0:22
Respiratory difficulties	0:4
Swallowing difficulties	0:5
Visceral response	0:4
Motor response	0:5
Facial or ocular response	0:3
If any other	Add (-1)
The total score of during feeding scale	0:29
First 5 min fost-feeding (oral feeding tolerance) scale	
The scale of behavioral organization	0:3
The scale of vital signs (cardiopulmonary stability)	0:4
Other clinical difficulties	0:17
Respiratory difficulties	0:4
Swallowing difficulties	0:3
Visceral response	0:4
Motor response	0:4
Facial or ocular response	0:2
If any other	Add (-1)
The total score of first 5 min post-feeding scale	0:24

MEFSA: Mansoura Early Feeding Skill Assessment, OFS: oral feeding skills.
Each item on the MEFSA has a scoring number range. The numbers on the left and right represent the minimum and maximum scales, respectively. The highest score obtained for each item indicates the best oral feeding performance among the infants. The sum of the scores is calculated at the end of each subscale.

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Table 2. Suggestions and recommendations regarding oral feeding

Oral or Ryle feeding
Continue Ryle feeding
Partial oral feeding
Oral feeding and removal of Ryle
Nipple level
Breastfeeding
Flow rate of NICU
Low flow rate
Level 1
Level 0
Suggested strategy
Not needed
Pacing
Endurance training
Sideline
Regulation
Jaw support
Stimulation
Not needed
Non-nutritive sucking
Oral stimulation
Combination of NNS and OS

NICU: neonatal intensive care unit, NNS: non-nutritive sucking, OS: oral-stimulation.

Close follow-up was performed using meal and daily follow-up sheets (**Appendix 2**). Furthermore, a feeding assessment every 72 hours was conducted using the MEFSA until FOF was achieved. Follow-up is needed to determine a safe, functional, and nurturing feeding experience and to assess the effectiveness of oral motor stimulation and the improvement of feeding skills.

3. Results analysis

The MEFSA data of each -participant were recorded and entered into a computer for statistical analysis. Data were analyzed using the commercially available IBM SPSS Statistics ver. 24.0 software (IBM Co.). Descriptive statistics were presented using qualitative data as number (n) and percentage (%), while quantitative variables were described, after testing for normality using the Shapiro–Wilk test, using mean±standard deviation and median (range). Statistical analysis was performed using one-way analysis of variance, the Monte Carlo test as a correction for the chi-square test, and the Mann–Whitney U-test (Z). The significance of the obtained results was judged at the 0.05 level (p-value <0.05 was used for statistically significant differences).

Materials and equipment

1. Brief overview of the material

We used the same nipples generally used in the NICU of MUCH, formula milk, or expressed milk; the MEFSA scale (**Appendix 1**); and meal/daily follow-up sheets (**Appendix 2**).

2. Brief overview of the equipment

The heart rate, respiratory rate, and oxygen saturation levels were measured using a vital sign monitor and oximeter. Furthermore, a watch that indicated seconds was used to calculate the feeding duration.

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RESULTS

Results of the literature review

The literature was reviewed for availableneonatal oral feeding assessment tools/scores, revealing that several authors had tried to use NNS assessment scores to indicate oral feeding readiness [11,12]. Neiva et al. [13] and Costa Schans [14] made suggestions for adjusting the NOMAS scale. In Brazil, Fujinaga [15] presented an NNS scoring instrument, and Neiva and Leone [16] developed an NNS scoring system to assess preterm infants with very low birth weight.

In most NICUs, SOF is commonly decided by the attending phoniatrician/speech pathologists following oral feeding readiness screening instruments [17] such as the NOMAS [14,18,19], Early Feeding Skills Assessment (EFS) [20], Premature Oral Feeding Readiness Assessment Scale (POFRAS) [21], Preterm Infant Nipple Feeding Readiness Scale (PINFRS) [22,23], and Infant Driven Scale (modified Italian scale) [24], and a rapid salivary proteomic platform for oral feeding readiness [25].

Once the infant is considered ready for SOF, the OFS evaluation is initiated. The OFS assessment has two protocols: coordination safety evaluation and effectiveness evaluation [26]. The coordination safety evaluation aims to assess whether oral feeding maintains physiological stability without signs of distress suggesting airway obstruction [26]. Several scales assess feeding in such a way: EFS [20], NOMAS [14,18,19], Bristol Breastfeeding Assessment Tool (BBAT) [27], Breastfeeding Evaluation and Education Tool (BEET) [28], Systematic Assessment of the Infant at Breast (SIAB) [29], Infant Breastfeeding Assessment Tool (IBFAT) [30,31], LATCH [31-33], Mother-Baby Assessment (MBA) [34], Mother-Infant Breastfeeding Progress Tool (MIBPT) [35], Potential Early Breastfeeding Problem Tool (PEBPT) [36], Premature Infant Breastfeeding Behavior Scale (PIBBS) [37], Schedule for Oral Motor Assessment (SOMA) [38], Functional Evaluation of Eating Difficulties Scale (FEEDS) [39], and Neonatal Feeding Assessment Scale (NFAS) [7].

While effectiveness evaluation considers if the amount of food taken is sufficient for growth requirements, the scale that supports this approach is the “OFS levels assessment score” [26].

The aforementioned scores in the literature have both strengths and limitations [7,8,13,21,23-25,27-29,37,39-45]. These points are summarized in **Table 3**.

Results of MEFSA scoring

Table 4 presents the results obtained using the MEFSA scores. It summarizes the mean total score of the “pre-feeding scale,” the “during feeding scale,” and the “post-feeding scale.” Furthermore, the percentage of sucking patterns by NOMAS and results of OFS assessment are presented.

Recommendations to support infant feeding regarding the feeding method and nipple level are summarized in **Table 5**. The suggested strategy was based on the cause of disorganization, and some infants required more than one strategy. Stimulation was chosen based on oral skill scores.

The required outcomes (smooth feeding transition, early SOF, FOF, and discharge with a shorter tube feeding period) are presented in **Table 6**.

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Table 3. Strengths and limitations of the availableneonatal oral feeding assessment tools/scores

The score	Strengths	Limitations
NOMAS	It is a visual observation tool that can better identify and quantify oral motor abilities in newborns [14,18,19].	NOMAS is not predictive of oral feeding performance, and instrumental evaluation is not included. Thus, the process of sucking is not objectively evaluated [23,40].
EFS	It can be used from SOF time to OFS maturation [7]. It measures physiologic stability indexed by sufficient oxygen saturation	It does not include formal content validity testing [41].
PINFRS	It indirectly measures feeding readiness but reliability and validation are still needed [23,24].	
Fujinaga NNS scoring tool	Fujinaga [15] presented an NNS scoring tool to identify and quantify NNS.	A cutoff point for SOF was not indicated [13].
POFRAS	It is an easy and quick instrument.	Evaluating the readiness for oral feeding based on NNS and behavioral data may not guarantee oral feeding success [8,21].
Neiva and Leone NNS scoring system	Neiva and Leone [16] presented a safe and accurate NNS scoring system with a cutoff point to SOF [13,16].	Depending only on NNS may not guarantee successful oral feeding [8].
Infant driven scale	Modified Italian scale that is a valuable instrument for early identification of infants at risk for delayed feeding independence [24].	
A rapid salivary proteomic platform aimed at translating five transcriptomic genes biomarkers in neonatal saliva into a fast proteomic platform to provide an objective, real-time assessment of OFS [25].		
BFAT	It is an effective breastfeeding assessment tool with good internal reliability.	It should be administered on a broader sample to establish its usefulness [27].
IBFAT	It is a checklist for scoring neonatal breastfeeding behaviors [30,31].	It observes only one feeding performance [42].
LATCH	It evaluates breastfeeding techniques [31-33].	It does not assess the infant's capability to manage milk flow and coordinate SSB [43].
MIBPT	It assesses the necessary skills for efficient breastfeeding and guides NICU support and education on the importance of breastfeeding [35].	
MBA	It is an assessment score of the mother and baby [34].	The development process of the MBA needs to be discussed, and there is no evidence of content validity [41].
PIBBS	It is a reliable instrument but not predictive of milk intake in preterm infants [37,44].	
PEBPT	It is a list of possible breastfeeding events [28]. However, it includes no formal content validity testing [41].	
SOMA	It can objectively rate the OFS of children aged 12-42 months. Its abbreviated version is suitable for screening infants aged 6 months [38] but not validated for preterm application. However, a new study suggests that it might be a complementary instrument for assessing preterm babies [45].	
FEEDS	It can evaluate newborns' ability to feed. Although it has relevant clinical advantages, sometimes the clinical complexity of these infants may affect the opportunity to administer this protocol. This is counterbalanced by integrating the score with clinical insights [39].	
NFAS	Researchers in South Africa developed the NFAS, which is 211 items across six sections, to diagnose the presence or absence of oropharyngeal dysphagia [7].	
BEET	had no scoring system and no psychometric testing [28]	
SIAB	had no scoring system and no psychometric testing [29]	
OFS levels assessment tool	It is an objective indicator of infants' skills and endurance. It can identify oral feeding problems caused by immature skills and/or poor endurance [17].	It may not reflect the stress signs of the infant during feeding [40].

NOMAS: neonatal oral motor assessment scale, EFS: Early Feeding Skills Assessment, PINFRS: Preterm Infant Nipple Feeding Readiness Scale, NNS: non-nutritive sucking, POFRAS: Premature Oral Feeding Readiness Assessment Scale, BBAT: Bristol Breastfeeding Assessment Tool, IBFAT: Infant Breastfeeding Assessment Tool, LATCH: latch, audible swallowing, type of nipple, comfort, and hold, MIBPT: Mother-Infant Breastfeeding Progress Tool, MBA: Mother-Baby Assessment, PIBBS: Premature Infant Breastfeeding Behavior Scale, PEBPT: Potential Early Breastfeeding Problem Tool, SOMA: Schedule for Oral Motor Assessment, FEEDS: Functional Evaluation of Eating Difficulties Scale, NFAS: Neonatal Feeding Assessment Scale, BEET: Breastfeeding Evaluation and Education Tool, SIAB: Systematic Assessment of the Infant at Breast, OFS: oral feeding skills, SOF: start oral feeding, NICU: neonatal intensive care unit.

In **Table 7**, the outcome results of mild (≤28 weeks GA), very (28:32 weeks GA), and extreme (32:36 weeks GA) preterm infants are shown.

DISCUSSION

Based on previous clinical appraisals of the various scales available in the literature, no single comprehensive feeding evaluation scale exists for premature populations. Furthermore, each available score has advantages and disadvantages. Consequently, the following question arises: Which tool or evaluation form enables researchers to evaluate and comprehensively describe the OFS of preterm infants? Owing to the shortage of literature, we aimed to develop a new scoring system for early feeding skills in preterm infants that fulfills the advantages of other tools and overcomes their limitations.

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Table 4. MEFSA score of assessed preterm infants

Parameters	Value (n=41)
Pre-feeding scale (oral feeding readiness & OFS)	
The scale of the behavioral organization (7:21)	19.8±1.6 (15–21)
The scale of vital signs (cardiopulmonary stability) (5:15)	14.7±0.84 (11–15)
Scale of reflexive oral motor skills (8:24)	22.3±1.7 (16–24)
The scale of non-nutritive sucking reflex (0:27)	23.3±2.8 (19–27)
The total score of the pre-feeding scale (20:87)	80.2±4.5 (67–87)
Nutritive sucking (NOMAS)	
Normal	13 (31.7)
Disorganized	26 (63.4)
Dysfunctional	1 (2.4)
Absent	1 (2.4)
During feeding scale (oral feeding maintenance)	
Maintain engagement in feeding (0:4)	4 (2–4)
Maintain vital signs (cardiopulmonary stability) (0:4)	4 (1–4)
Other clinical difficulties (0:22)	
Respiratory difficulties (0:4)	4 (2–4)
Swallowing difficulties (0:5)	5 (1–5)
Visceral response (0:4)	4 (2–4)
Motor response (0:5)	5 (3–5)
Facial or ocular response (0:3)	3 (2–3)
The total score of during feeding scale (0:29)	27.2±2.2 (21–29)
OFS of the assessed preterm infants (n=40*)	
Success	
No (<80%)	10 (25.0)
Yes (≥80%)	30 (75.0)
Proficiency %	
<30%	6 (15.0)
≥30%	34 (85.0)
Rate of milk transfer (mL/min)	
<1.5 mL/min	8 (20.0)
>1.5 mL/min	32 (80.0)
Oral feeding skill levels	
OFS level 1	4 (10.0)
OFS level 2	2 (5.0)
OFS level 3	4 (10.0)
OFS level 4	30 (75.0)
First 5 min post-feeding scale (oral feeding tolerance)	
The scale of behavioral organization (0:3)	3 (2–3)
Scale of vital signs (cardiopulmonary stability) (0:4)	4 (3–4)
Other clinical difficulties (0:17)	
Respiratory difficulties (0:4)	4 (3–4)
Swallowing difficulties (0:3)	3 (3–3)
Visceral response (0:4)	4 (3–4)
Motor response (0:4)	4 (3–4)
Facial or ocular response (0:2)	2 (2–2)
The total score of 1st 5 min post feeding scale (0:24)	23.8±0.4 (22–24)

Values are presented as mean±standard deviation (range), number (%), or median (range).
MEFSA: Mansoura early Feeding Skill Assessment, OFS: oral feeding skills, NOMAS: neonatal oral motor assessment scale.
*The baby without nutritive sucking was excluded.

The MEFSA includes three complementary sections: pre-feeding, during feeding, and post-feeding. The "pre-feeding" section assesses the infant's readiness for SOF. The "pre-feeding" section of MEFSA considers the behavioral organization and the vital signs measured using a vital sign monitor and an oximeter and then performs oral motor reflexes. This section takes approximately 3–5 minutes. We continued with the next section when the infant was ready. If the infant was not ready, specific oromotor exercises were recommended based on the

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Table 5. Suggestions and recommendations regarding oral feeding

Parameters	Value
Oral or Ryle feeding (n=41)	
Continue Ryle feeding	1 (2.4)
Partial oral feeding	11 (26.8)
Oral feeding and removal of Ryle	29 (70.8)
Nipple level (n=40)	
Breast-feeding	3 (7.5)
Flow rate of NICU	30 (75)
Low flow rate	5 (12.5)
Level 1	1 (2.5)
Level 0	1 (2.5)
Suggested strategy* (n=40)	
Not needed	13 (32.5)
Pacing	20 (50.0)
Endurance	11 (27.5)
Sideline	6 (15.0)
Regulation	2 (5.0)
Jaw support	1 (2.5)
Stimulation (n=41)	
Not needed	10 (24.4)
Non-nutritive suckling	22 (53.7)
Non-nutritive suckling+oral stimulation	9 (21.9)

Values are presented as number (%).
NICU: neonatal intensive care unit.
*The baby without nutritive sucking was excluded, and the data are not mutually exclusive.

Table 6. The needed outcomes regarding postmenstrual age and weight characteristics of oral feeding (SOF, FOF, and transition) and discharge

Parameters	Value (n=41)
Birth weight (g)	1,747.0±519.1
GA (wk)	32.8±1.97
Transition from Ryle to SOF (d)	4 (1–24)
SOF weight (g)	1,683.7±429.9
SOF PMA (wk)	33.74±1.87
Period of transition from SOF to FOF (d)	2 (2–9)
FOF weight (g)	1,750.5±437.5
FOF PMA (wk)	34.15±1.79
Discharge weight (g)	2,049.9±457.1
Discharge PMA (wk)	35.65±1.81
Total parenteral nutrition duration (d)	5 (2–26)
Total period of stay in NICU (d)	17 (5–56)

Values are presented as mean±standard deviation or median (range).
SOF: start oral feeding, FOF: full oral feeding, GA: gestational age, PMA: postmenstrual age, NICU: neonatal intensive care unit.

Table 7. Needed outcomes in the prematurity classes

Parameters	Mild preterm group (n=27)	Very preterm group (n=11)	Extreme preterm group (n=3)
Birth weight (g)	1,955±408.8	1,468.2±472.8	896.7±55.1
SOF weight (g)	1,867.9±317.6	1,435±386.8	936.7±37.9
FOF weight (g)	1,932.8±343.6	1,495.9±382.8	1,043.3±77.7
Discharge weight (g)	2,183.5±479.2	1,815.5±307.6	1,706.7±30.6
SOF to FOF (d)	2 (2–5)	3 (2–5)	5 (2–9)
GA (wk)	33.96±0.76	31.46±0.69	27.67±0.59
SOF PMA (wk)	34.8±1.07	32.24±0.7	29.67±0.41
FOF PMA (wk)	35.13±1.11	32.73±0.84	30.53±0.17
Discharge PMA (wk)	36.31±1.73	34.37±1.39	34.53±0.96

Values are presented as mean±standard deviation or median (range).
SOF: start oral feeding, FOF: full oral feeding, GA: gestational age, PMA: postmenstrual age.

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infant's existing skills. In the "during feeding" section, we try to cover all stress signals that may appear during the feeding session. The items in the later section are observed during infant feeding. If an infant demonstrated breakdown during feeding, strategies were used to enhance feeding performance. The "during feeding" section takes a maximum of 20 minutes according to each infant's feeding skills and mealtime. The "post-feeding" section evaluates the infant's ability to recover and self-regulate after oral feeding. The "post-feeding" section takes 5 minutes to observe the infant. Accordingly, the three sections are complementary and cover the entire feeding task, as our role as a phoniatrician/speech pathologist is to assess the infant before feeding and observe them during and after feeding to bypass this critical period and achieve safe, efficient, and functional FOF.

Our results were more favorable than those reported by Giannì et al. [24] regarding the needed oral feeding and discharge outcomes. In addition, our study outcomes were better for all classes of premature infants than those reported by Prade et al. [46] and Lau and Smith [17] regarding oral feeding and discharge. These data denoted that we successfully developed a new bedside scoring system, the "MEFSA" by combining the three sections with appropriate individualized interventions and close follow-up.

Our future research will investigate the cutoff point of the oral feeding readiness section of the MEFSA in relation to OFS using the total score of the pre-feeding scale with regard to oral feeding skill level. Furthermore, the correlation among the subtotal scores of the MEFSA sections will be investigated. This correlation means that when infants appear ready for the pre-feeding section, they will safely pass during the feeding section. In addition, when infants maintain feeding during the feeding session, they will show efficient feeding tolerance in the post-feeding section.

Limitations

This study encountered some challenges in the multidisciplinary team for oral feeding in the NICU of MUCH. Changing the feeding culture requires time and building trust in the safety of the feeding method. Lastly, this was a single-center study with a small sample size; therefore, the findings cannot be generalized to the general population.

Conclusion

The MEFSA score successfully provided a cue-based functional oral feeding approach. It is a successful bedside scoring system that assesses OFS in the NICU.

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Appendix 1

Mansoura Early Feeding Skills Assessment (MEFSA) Score.

Appendix 1

Mansoura University Hospitals
E.N.T Department
Phoniatrics Unit

مستشفيات جامعة المنصورة
قسم الانف والاذن والحنجرة
وحـدة امراض التـخـاطـب

Mansoura Early Feeding Skills Assessment (MEFSA) Score

مقياس المنصورة لتقييم مهارات التغذية للرضع

▪ **Name**	
▪ **Date of assessment**	
▪ **Assessment Number**	
▪ **Birth Date**	
▪ **Admission to NICU date**	
▪ **Birth Weight**	
▪ **Birth nutritional status**	
▪ **Current Weight**	
▪ **Gestational Age**	
▪ **Current Post menstrual age or current gestational Age**	
▪ **Perinatal History**	
✓ **Complication During Pregnancy**	
✓ **Delivery History**	
➢ Vaginal or CS	
➢ Single birth or Multiple birth	
➢ APGAR Score (if present)	
✓ **Post natal complication Any affected System , Medical or Surgical condition**	
✓ **Current route of feeding**	

Pre-Feeding Scale (Oral Feeding Readiness & Oral Feeding Skills):	
▪ Scale of behavioral organization	
▪ Scale of vital signs (Cardiopulmonary Stability)	
▪ Scale reflexive oral motor skills	
▪ Scale of non-nutritive sucking reflex	
Nutritive Sucking	
During feeding (Oral Feeding Maintenance):	
▪ Maintain Engaged in Feeding	
▪ Maintain Vital Signs (Cardiopulmonary Stability)	
▪ Other Clinical Difficulties	
Oral feeding skill level	
1st 5min Post feeding (oral feeding tolerance):	
▪ Behavioral Organization	
▪ Vital Signs (Cardiopulmonary Stability)	
▪ Other Clinical Difficulties	

Suggested strategy	Not need	Need	…… …… ……

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Pre-Feeding Scale
(Oral Feeding Readiness & Oral Feeding Skills)

Scale of behavioral organization	3	2	1
▪ Behavioral State	Alert	Sleep	Crying or Drowsy
▪ Respiration	Room air	O2 in incubator	Nasal O2 cannula
▪ Skin Color	Normal	Jaundice	• Cyanosis • Pallor
▪ Need of Secretion Aspiration	Unnecessary	Seldom (1:2/day)	Frequent (>2/day)
▪ Routine Care Handling	Tolerate	Just Irritability	Couldn't Tolerate
▪ Global Posture	Flexed	Partially flexed	Extended
▪ Global Tonus	Normotonia		• Hypotonia • Hypertonia

Scale of vital signs (Cardiopulmonary Stability)	3	1
▪ O2 saturation	≥ 92 % (Basal = …….)	< 92 %
▪ Respiratory Rate	≤ 60 br/min (Basal = ……..)	> 60 br/min
▪ Use of accessory muscle	No use	Suprasternal or Subcostal retraction
▪ Heart Rate	100 :180 b/min (Basal = …..)	• Tachycardia • Tachypnea
▪ Temperature	Normal	• Fever • Hypothermia

Scale of Reflexive Oral Motor Skills	3	1	
▪ Transverse tongue reflex	Goal directed	Non goal directed	No response
▪ Tongue reflex	Normal	Absent	
▪ Biting reflex	Normal	Exacerbated (Tonic bite)	
▪ Grasp reflex	Present	Absent	
▪ Palmo-mental reflex	Present	Absent	
▪ Perioral sensitivity	Present	Exaggerated	Absent
▪ Intraoral sensitivity (Gag reflex)	Present	Exaggerated	Absent
▪ Rooting reflex	Effective	Absent or need encouragement	

Non-Nutritive Sucking (1min)	3	1	0
▪ **Easy initiation of sucking**	Spontaneous	Need stimulation	Absent
▪ **Ability to latch (labial sealing)**	Good	Poor	
▪ **Coordination () lip, tongue & jaw**	Good	Poor	
▪ **Suck – pause**	5 :8	>8 <5	
▪ **Rate**	2/sec	More or less	
▪ **Strain**	Strain	Weak	
▪ **Stress signals**	Absent	Present	
▪ **Habituation**	Absent	Present	
▪ **Preservation**	Absent	Present	

Nutritive Sucking Reflex (2min) By NOMAS	Normal	Disorganized	Dysfunctional	Absent

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During Feeding
(Oral Feeding Maintenance)

Maintain Engaged in Feeding	2	1
▪ State	Maintain	Not maintain
▪ Global posture	Maintain	Not maintain
▪ Sucking (Force & Rhythm)	Maintain	Not maintain
▪ Refuse of food & Gaze aversion (looking away)	No	Yes

Maintain Vital Signs (Cardiopulmonary Stability)	2	1
▪ O2 saturation drops < 90 %	No	Yes
▪ Respiratory Rate (Rise or Drop)	No	Yes
▪ Heart Rate (Rise 15 beats above baseline or Drops < 100 b/min)	No	Yes
▪ Skin color changes (Cyanosis or Pallor or Flushing)	No	Yes

Other Clinical Symptoms		2	1
Respiratory difficulties	▪ Apnea or Stop sucking to breath	No	Yes
	▪ Stridor or Grunting (Any noisy breathing)	No	Yes
	▪ Dyspnea & Substernal or suprasternal retraction	No	Yes
	▪ Nasal flaring	No	Yes
Swallowing difficulties	▪ Coughing / Chocking	No	Yes
	▪ Multiple swallow to clear bolus	No	Yes
	▪ Wet voice or gurgling sound	No	Yes
	▪ Nasal spit up	No	Yes
	▪ Bolus stagnation & Milk Drooling	No	Yes
Visceral response	▪ Gaging & Vomiting	No	Yes
	▪ Hiccups	No	Yes
	▪ Sneezing	No	Yes
	▪ Yawning	No	Yes
Motor response	▪ Arching	No	Yes
	▪ Frantic flailing movement (position & baby support)	No	Yes
	▪ Finger or toes splaying	No	Yes
	▪ Salute (hand blocking face)	No	Yes
	▪ Epileptic attack or Tremors	No	Yes
Facial or Ocular response	▪ Glassy eye (tuning out) & Staring	No	Yes
	▪ Panicked or painful look	No	Yes
	▪ Grimacing or frowning	No	Yes
Others	▪ Any other findings ……..	For one present → -1	

Oral feeding skill level

▪ **Overall transfer**	$(volume\ taken)/(total\ perscribed\ )$	……/…… =
▪ **PRO**	$(volume\ in\ 1st\ 5min)/(total\ perscribed\ )$	……/…… =
▪ **RT**	$(volume\ taken)/(time\ )$	……/…… =
☒ Success		
☒ Oral feeding skill level		

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1st 5min Post-Feeding (Oral Feeding Tolerance)

Behavioral Organization	2	1	
▪ State	Sleepy or Calm	Drowsy	Crying & Irritable
▪ Global posture	Same as pre-feeding	Changed	
▪ Need of secretion aspiration	Same as pre-feeding	Increase need	

Vital Signs (Cardiopulmonary Stability)	2	1
▪ O2 saturation	Same as pre-feeding	Changed
▪ Respiratory Rate	Same as pre-feeding	Changed
▪ Heart Rate	Same as pre-feeding	Changed
▪ Skin color changes (Cyanosis or Pallor or Flushing)	No	Yes

Other Clinical Difficulties		2	1
Respiratory difficulties	▪ Apnea	No	Yes
	▪ Stridor or Grunting (Any noisy breathing)	No	Yes
	▪ Dyspnea & Substernal or suprasternal retraction	No	Yes
	▪ Nasal flaring	No	Yes
Swallowing difficulties	▪ Coughing / Chocking	No	Yes
	▪ Nasal spit up	No	Yes
	▪ Wet voice or gurgling sound	No	Yes
Visceral response	▪ Vomiting	No	Yes
	▪ Hiccups	No	Yes
	▪ Abnormal colonic movement or passing gas	No	Yes
	▪ Sneezing	No	Yes
Motor response	▪ Arching	No	Yes
	▪ Frantic flailing movement	No	Yes
	▪ Epileptic attack or Tremors	No	Yes
	▪ Salute (hand blocking face)	No	Yes
Facial or Ocular response	▪ Glassy eye (tuning out) & Staring	No	Yes
	▪ Panicked or painful look	No	Yes
Others	▪ Any other findings ……..	For one present → -1	

Recommendation

▪ Oral or Ryle feeding	
▪ Nipple level	
▪ Strategy during feeding	
▪ Stimulation	

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Appendix 2

Meal follow-up sheet.

Appendix 2

Meal follow up sheet

▪ Name		
▪ Date		
▪ Time of feeding		
▪ Nurse name		
▪ Total amount (a+b)		
a) Amount gavage		
b) Amount oral		
▪ Duration of feeding		
	Yes	No
▪ Easy initiation		
▪ Use of suggested strategy		
▪ Infant engagement in feeding		
▪ Nurse effort		
▪ Stress signal during feeding		
▪ Stress signals after feeding		

Daily follow up sheet

▪ Name	
▪ Date	
▪ Feeding schedule	
▪ Suggested strategy	
▪ Current Weight	
▪ Current Gestational Age	
▪ Amount of milk/day	
▪ Amount (oral/total)	
▪ Number of oral feeding	
▪ Weight gain	
▪ Signs of chest infection or other distress	

	9 a.m.	11 a.m.	1 p.m.	3 p.m.	5 p.m.	7 p.m.	9 p.m.	11 p.m.	1 a.m.	3 a.m.	5 a.m.	7 a.m.
▪ Nurse name												
▪ Total amount												
a) Amount gavage												
b) Amount oral												
▪ Duration of feeding												
☒ Yes / No												
▪ Easy initiation												
▪ Use of suggested strategy												
▪ Infant engagement in feeding												
▪ Nurse effort												
▪ Stress signal during feeding												
▪ Stress signals after feeding												

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