

Translation and Validation of Neonatal Feeding Assessment Scale (NFAS) in Persian

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ABSTRACT

Background: Feeding difficulties and dysphagia can lead to malnutrition, dehydration, pneumonia, prolonged hospitalization, and even death in neonates. Accordingly, it should be recognized as soon as possible to provide necessary medical care, nursing, and rehabilitation. This study aimed to translate the Neonatal Feeding Assessment Scale (NFAS) into Persian and determine its psychometric properties in Iranian neonates.

Methods: After receiving permission from developers, the main version of NFAS was translated into Persian. Face validity of NFAS was assessed by 10 qualified speech and language pathologists in the field of pediatric swallowing. In order to define the internal consistency of the items, 52 infants were evaluated using the Persian version of NFAS, and the correlation between the items was determined using Kuder-Richardson 20. The test-retest and inter-rater reliabilities were also calculated by Cohen's Kappa coefficient in 30 and 40 infants, respectively. The convergent reliability between NFAS and Early Feeding Skills (EFS) was calculated by point-biserial correlation in 30 infants.

Results: According to experts, all translated items were transparent and understandable. The internal consistency score was obtained at 0.76. Moreover, Cohen's Kappa coefficients were calculated at 0.96 and 0.87 for test-retest and inter-rated reliabilities, respectively. Point biserial correlation between Persian NFAS and EFS was estimated at 0.63.

Conclusion: Persian version of NFAS is a valid and reliable tool to assess feeding problems and oro-pharyngeal dysphagia in infants and make clinical decisions.

Keywords: Dysphagia, Neonate, Validity, Swallowing

Introduction

Feeding involves the process of receiving food, placing it in the mouth, and swallowing. In normal infants, feeding skills develop sequentially along with other motor skills with age (1).

Normal swallowing consists of four stages, including the oral preparatory phase, oral transfer phase, pharyngeal phase, and esophageal phase (2). Dysphagia, as one of the forms of feeding disorders, is caused by abnormal changes in the structures, function, or coordination of movements that are necessary for normal swallowing (3) that impairs the safety,

effectiveness, and adequacy of feeding. Swallowing disorders in infants are mainly caused by five major reasons, such as neurologic matters (e.g., prematurity and cerebral palsy); anatomical abnormalities which affect aero-digestive tract (e.g., cleft palate); medical conditions (e.g., syndromes, as well as metabolic and degenerative diseases); conditions affecting sucking, swallowing, and breathing coordination; and other factors (e.g., feeder-child interaction dysfunction) (2, 4) that mainly results in poor suck-, swallow- breath coordination and

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weak/delayed oral sensorimotor skills with symptoms, such as feeding-related Bradycardia and desaturation, coughing, choking, gagging, arching the back, irritability, and refusal to feed (5).

Though the exact prevalence of neonatal dysphagia is not known, swallowing problems are nearly frequent in prematurely born infants and high-risk neonates in the neonatal intensive care units (NICU) (6). The prevalence of dysphagia was estimated high (about 10.27%) in newborns at the NICU of hospitals affiliated to Tehran University of Medical Sciences, Tehran, Iran (7). The prevalence rate is expected to be higher in small towns or suburbs of the cities due to higher rates of inadequate prenatal care and premature births.

A complete and comprehensive evaluation is the first necessary step in the early detection of feeding and swallowing problems to survive the child and achieve appropriate therapeutic intervention.

Videofluoroscopy (VFSS) or modified barium swallow test (MBS), fiber-optic endoscopic evaluation of swallowing (FEES), and ultrasound sonography (US) are used for the instrumental assessment of infants' swallowing (8, 9). VFSS is the most comprehensive instrument that can assess all four phases of swallowing by irradiating X-rays with barium-containing foods (10, 11). In FEES, the hypopharynx and larynx can be observed directly during swallowing by passing the endoscope through the nose (12). The US is a noninvasive accurate method for the detection of swallowing problems, specifically in neonates in the oral phase (13).

Although instrumental assessment is the most effective way to identify dysphagia, it also has disadvantages and limitations. Almost all of these techniques are expensive and need highly educated and trained specialists. VFSS is invasive and exposes the neonates to radiation, and the US provides only the views of the oral phase and no other (14).

In addition, one of the important limitations in developing and under sanctions countries, such as Iran, is the lack of access to these instruments or the lack of experts to conduct procedures, even in metropolitan areas. Therefore, access to valid, reliable, and efficient clinical scales, as a supplement or even an alternative for instrumental evaluations, is so important to identify infants with oropharyngeal dysphagia (OPD).

In 1993, Palmer et al. developed the Neonatal Oral Motor Assessment Scale (NOMAS) to assess jaw and tongue function during sucking (15). A

Schedule for Oral Motor Assessment (SOMA) was also developed in 1995 by Riley et al. to evaluate the function of the lips, tongue, and jaw of 8- to 24-month-old children by eating fluids and foods of varying concentrations (16). These two tools merely assess the motor function of the mouth, while in a comprehensive assessment of an infant with a feeding disorder, the overall process of swallowing and feeding, the role of environment (e.g., parental concerns and the parent-child interaction), infant's internal disturbances, health status, state, and behavior should be taken into account (17).

Thoyre et al. (2005) developed Early Feeding Skills (EFS) to assess the readiness for the improvement of oral feeding skills in preterm infants (18, 19). Despite not evaluating all necessary factors in oral feeding, EFS is more comprehensive than NOMAS and SOMA. However, the clinician-reported checklist is the best substitution for studying the emergence of early feeding skills in premature infants; however, it is not suitable for all neonates who are at high risk for OPD (children with certain syndromes, anatomical abnormalities, and congenital heart defects); moreover, it does not clearly focus on identifying neonates who are suspected of having swallowing disorders.

In 2016, Vivier et al. designed the Neonatal Feeding Assessment Scale (NFAS) using the Delphi method in English to comprehensively assess feeding skills in infants from 32 weeks of gestation to the end of 4 months (adjusted for preterm infants) and diagnose OPD. NFAS is a valid and reliable scale with 228 items. Its inter-rater reliability, sensitivity, and specificity were determined at 80%, 100%, and 78.6%, respectively, which are satisfactory (20, 21).

After a widespread literature review, to find a validated clinical instrument that provides a detailed profile of feeding behaviors of neonates and supports an accurate diagnosis of OPD in high-risk neonates to be used for Iranian neonates, in the situation of lack of access to instrumental examinations, NFAS was found as a comprehensive scale that provides these objectives.

This study aimed to translate the neonatal feeding assessment scale into Persian and define its psychometric properties.

Methods

Process of Translation and Cross-Cultural Adaptation

In this methodological study, after obtaining

permission from the original designer, (Dr. Viviers), NFAS was translated into Persian using the standard backward/forward method in three steps as follows.

In the first step, two fluent English translators who were unfamiliar with NFAS translated the original scale into Persian independently. Each translator determined the level of translation difficulty for each item by scoring on a 100-point visual scale. Following that, in a panel with researchers and translators, they were compared and unified into one version. At the third step, the final Persian version was retranslated into English by two different translators, and the unified version emailed to the main developer who confirmed its structural and content similarity.

To define face validity, the guidelines were followed (22); accordingly, 10 experienced speech and language pathologist who had at least five years of experience in the field of pediatric swallowing and feeding problems scored the Persian-NFAS qualitatively based on the clarity and intelligibility of items (completely clear/unclear, need revision). Essential corrections were made in items regarding the experts' comments to enhance clarity. For some items that needed an additional explanation, the main developers of NFAS were consulted and explanations were added. Again, the experts were asked to comment on the clarity and transparency of the items. This process continued until the clarity and transparency of all items were approved by experts.

Participants

The study sample consisted of 52 neonates at 32-56 weeks postmenstrual age who were hospitalized at the NICU of Akbar Pediatrics' Hospital, Mashhad, Iran, in 2020. The neonates met the inclusion criteria that were being at high risk for swallowing and feeding problems (prematurity, low birth weight, and presence of oro-facial malformations, as well as gastrointestinal, cardiovascular, or neurological disorders), and having a medically stable condition for evaluation as approved by the neonatologist.

A trained speech and language pathologist collected data using the infant's medical records (i.e., gender, gestational and current adjusted age, birth and current weight, and diagnosis) and NFAS. For every child, the purpose of the study was explained to the mothers and informed consent was obtained from them.

NFAS consisted of 228 items in six subsections

of physiologic subsystems (29 items), state of alertness (7 items), stress cues during feeding (35 items), general motor and muscle tone screening (12 items), oral peripheral evaluation (78 items), and clinical evaluation of feeding and swallowing function (67 items). Each item is scored on a double "Yes/No" scale. If three or more responses attained in the outcome section indicated "Yes", and at least one of these three "Yes" responses belonged to "oral peripheral evaluation" or "clinical evaluation of feeding and swallowing function" subsections, the final conclusion is the probable presence of OPD (20, 21).

The assessments were performed during infants' usual mealtime; however, some parts were conducted during feeding (all sections) and other parts at rest (general motor and muscle tone screening and oral peripheral evaluation) in the presence of their mothers. Every assessment took maximum of 30 minutes.

Evaluation of psychometric properties

Reliability assessment

Reliability is the degree of consistency of a measure (23). In this study, three different types of reliability measures, including internal consistency, inter-rater reliability, and test-retest were used to determine the reliability of the Persian version of NFAS. The obtained data were analyzed in SPSS software (version 22).

Internal consistency

To determine the internal consistency, 52 infants (29 males and 24 females) aged 32 to 42 weeks who were bottle or breastfed based on the neonatologist's order were selected by simple sampling method, and the Persian-NFAS was completed for them. The correlation among subscales was determined using Kuder-Richardson 20. Minimally acceptable levels of internal consistency calculated greater than 0.7 show satisfactory internal consistencies (24). A minimum sample size of 30 is generally considered sufficient for the estimation of internal consistency (25).

Test-retest reliability

To investigate the test-retest reliability, 30 infants were randomly selected from the whole sample, and after one day, they were retested by Persian NFAS under the completely similar condition (feeder, feeding method, mealtime, as well as place and time of evaluation). Considering the categorical type of variables, Cohen's Kappa coefficient was used to determine

Table 1. Interpretation guidelines for kappa values for inter-rater reliability

Kappa values	Interpretation of level of agreement	Kappa values	Interpretation of level of agreement
1.00	Perfect	>0.75	Excellent agreement beyond chance
0.93-0.99	Excellent		
0.81-0.92	Very good	0.40-0.75	Good agreement beyond chance
It 0.61-0.80	Good		
0.41-0.60	Fair/substantial	<0.40	Poor agreement beyond chance
0.21-0.40	Slight		
0.01-1.20	Poor		
≤0	No agreement	-	-

the stability of the final result and the results of each subscale of Persian-NFAS between two evaluations. Generally, a sample size of 30 participants was sufficient to study the test-retest reliability (26). The interpretation of the inter-rater reliability calculations (Kappa) according to Dawson and Trapp (2004) and Landis and Koch (1977) are provided in Table 1. A Kappa value of greater than 0.41 was considered a minimal reliability criterion (27).

Inter-rater reliability

To estimate the inter-rater reliability, a nurse with 16 years of experience at the NICU and six hours of training for the execution of Persian-NFAS reassessed 40 infants simultaneously with the first examiner. Cohen's Kappa coefficient was also used to investigate the inter-rater reliability (26).

Convergent validity

To determine convergent validity, 30 infants were assessed by NFAS and EFS simultaneously. Point biserial correlation was used to calculate the correlation (28). Correlation is perfect, strong, moderate, or weak if Pearson's correlation coefficients are obtained at 1, 0.7-1, 0.4-0.7, and 0.1-0.4, respectively (29).

Ethical approval

This study was extracted from a research project approved by the Research Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (IR.MUMS.REC.1399.329). Parents were informed of the study objectives and procedures. Moreover, they were ensured that participation was voluntary. It is worth

mentioning that informed consent was obtained from all parents.

Results

Sample data

Table 2 demonstrates the participant characteristics. The participants' mean gestational and post-menstrual ages were 35 (SD=2.00) and 38 weeks (SD=2.00), respectively. Moreover, the mean birth and current weights were determined at 2.51 (SD=0.82) and 2.62 kg (SD=0.76), respectively. The participants' risk factors related to feeding problems were prematurity (71.1%, n=37), esophageal atresia (17%, n=9), cleft palate (3.8%, n=2), hydrocephalus (3.8%, n=2), respiratory distress syndrome, and asphyxia (3.8%, n=2). Table 3 indicates the results of NFAS obtained by the main examiner from 53 participants.

Translation

The overall results showed that the translation and equivalent processes of the NFAS had good and acceptable quality. Furthermore, one of the main developers confirmed the translation process and overall quality of the NFAS.

Face validity

The clarity and understandability of all translated items were verified by experts.

Reliability

Internal consistency

Internal consistency of NFAS was estimated by Kuder-Richardson 20 formula and calculated at 0.76 which was indicative of acceptable internal consistency.

Table 2. Participant characteristics (n=52)

Infant characteristics	Mean	SD	Min	Max
Gestational age (weeks)	35.00	2.00	30	32
Post menstrual age (weeks)	38.00	2.00	40	46
Birth weight (g)	2510	82	1140	4800
Current weight (g)	2620	76	1140	4200

Table 3. Persian-NFAS results (n=52)

Section	Number of infants with probable OPD	Frequency distribution (%)
A. Functioning of physiological subsystems†	6	11.5
B. State of alertness during feeding†	0	0
C. Stress cues during feeding	6	11.5
D. Movement and muscle tone screening	0	0
E. Oral peripheral examination	27	51.9
F. Clinical feeding and swallowing evaluation	30	57.6
Diagnostic outcome	9	17.3

OPD: oropharyngeal dysphagia

† Scoring of Sections A and B are combined on the NFAS.

Test-retest reliability

Test-retest reliability of the scale was obtained by Cohen's Kappa coefficient. In total, 29 participants were assessed by Persian-NFAS two times at one-day intervals. Cohen's Kappa values between 0.7 and 0.8 indicate the stability of the results among consecutive evaluations (Table 1). Kappa values for different subsections of the Persian version of NFAS ranged from 0.86 to 1. The Kappa value of the final diagnosis was estimated at 0.96 (Table 4).

Inter-rater reliability

As can be observed in Table 4, the Kappa values of A and B, as well as C and E sections were 0.81-0.92; in addition, this corresponding value was obtained at 0.61-0.80 for section F. Kappa 1.00 was determined for section D, and 0.87 was estimated for the final diagnostic outcome of participants (n=40).

Convergent validity

Point-bi-serial coefficient was estimated at 0.63 (n=30).

Table 4. Test-retest and inter-rater-reliability scores

Section of NFAS	Kappa	Level of agreement between raters (n=40)	Kappa	Level of agreement between test- retest (n=40)
Functioning of physiological subsystems	0.9	Very good agreement	0.96	Excellent agreement
State of alertness during feeding	0.85	Very good agreement	0.96	Excellent agreement
Stress cues during feeding	1.00	Perfect agreement	1.00	Perfect agreement
Movement and muscle tone screening	0.82	Very good agreement	0.96	Excellent agreement
Oral peripheral examination	0.75	Good agreement	0.86	Very good agreement
Clinical feeding and swallowing evaluation	0.87	Very good agreement	0.96	Excellent agreement
Total score of NFAS				

Discussion

The current study confirmed the face validity, internal consistency, test-retest reliability, inter-rater reliability, and convergent validity of the Persian version of NFAS. Internal consistency values between all subsections and diagnostic outcome of NFAS was also satisfactory. Moreover, test-retest and inter-rater reliabilities were calculated at 0.96 and 0.87, respectively, which showed great reliability. The convergent reliability revealed a moderate correlation between Persian-NFAS results and EFS scores. Therefore, the Persian version of NFAS is a valid and reliable scale to assess the overall feeding process and extract swallowing problems in Iranian infants from 32 weeks gestation to 56 weeks postmenstrual. Through the accurate observation of physiological control, alertness, and whole-body sensory-motor control, the suitability of oral structure and functions were assessed during the rest, feeding, as well as signs and symptoms of dysphagia. It provides Iranian

speech and language therapists, other multidisciplinary team members, including nurses and physicians at NICU, with a valid and reliable scale for making decisions about the suitability of the feeding process, as well as the method and probable presence of OPD. Though tube feeding is critical for the optimal growth of most preterm infants, there are few infants who can adequately be fed orally from birth. Accordingly, in the absence of detailed clinical evaluation scales, unnecessary enteral feeding method in these infants can lead to increased unnecessary health care costs and family stress (30). The process of development, the content of NFAS, and its primary psychometric properties were discussed in previous studies (20, 21). It provides information about infants' general physiological stability during the rest and feeding times, the effects of feeding on infants' state of alertness and vice versa, presence of any stress cues during feeding, nutritive and non-nutritive suck patterns, oral structure and functions, as well as primitive oral

reflexes (20).

Inter-rater reliability, sensitivity, and specificity of the main version of NFAS were reported to be 80%, 100%, and 78.6%, respectively (21). As can be observed in Table 4, the inter-rater reliability of the Persian-NFAS is also great (87%). The validity of NFAS for early identification of OPD in moderate to late preterm neonates was 93%; however, its inter-rater reliability was substantial beyond chance (31).

Pados et al. systematically reviewed the literature to identify validated feeding assessment scales for infants younger than six months. Although they found a lack of such scales, 11 assessment tools were mentioned and described in their study. These scales included The Breastfeeding Evaluation and Education Tool, Systematic Assessment of Infant at Breast, Infant Breastfeeding Assessment Tool (IBFAT), Mother-Baby Assessment (MBA), Potential Early Breastfeeding Problem Tool (PEBPT), Mother-Infant Breastfeeding Progress tool (MIBPT), Bristol Breastfeeding Assessment Tool (BBAT), LATCH, Preterm Infant Breastfeeding Behavior Scale (PIBBS), EFS, and NOMAS. Only the last four of them can assess swallowing, and psychometric properties have not been considered for the first two of them (32). The IBFAT was developed to assess rooting reflex, fixing, and sucking in infants. Its inter-rater reliability was determined at 70%-78% (33). The MBA examines effective feeding of infants the inter-rater reliability of which in a study with 46 samples was estimated at 81%-88% (34, 35). The PEBPT assesses 23 events of breastfeeding and its internal consistency was obtained at 0.81 (36). The MIBPT was developed to evaluate mother and infants' behavior in order to facilitate feeding. Its content validity was acceptable and inter-rater reliability was determined at 79%-95% (37). The BBAT can assess positioning, attachment, sucking, and swallowing. Its inter-rater reliability was 78%; however, the internal consistency was 76% that is not acceptable (38). The PIBBS was developed to determine the infants' capability of feeding, and its inter-rater reliability was acceptable (39). The LATCH assesses latching, audible swallowing, type of nipple, comfort, and holding. Its inter-rater reliability was more than 85% (40-42).

One of the most important advantages of NFAS over other comparable assessment tools, such as EFS and NOMAS, is its good diagnostic power to recognize neonates and infants with OPD, which is very important for the accurate assessment of oral feeding proficiencies and recognizing OPD in

neonates, especially in the underdeveloped areas where the delivery service is not well-regulated. However, due to the lack of access to instrumental evaluation equipment, such as MBS in Mashhad, to be used as the reference standard for primary identification of neonates/infants with OPD, it was not possible to examine the diagnostic accuracy of the Persian version of NFAS in this study and it should be mentioned in follow-up studies in other cities in Iran.

Another limitation of this study was the absence of a speech therapist employed in the sampling hospital to cooperate in the project as the second-rater so that a hired nurse at the NICU acted as the second-rater. However, good inter-rater reliability scores demonstrate that multidisciplinary team members could be able to use this instrument if they were sufficiently trained for its administration.

Conclusion

The results of this study suggest that the Persian-NFAS is valid and reliable, and it can be used to diagnose feeding disorders and OPD in infants.

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Conflicts of interest

The authors declare that they have no competing interests.

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