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Clinical validation of the infant-driven feeding scales© in Turkey

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ABSTRACT

Background: Supporting the development of feeding skills among preterm infants is an important component of neonatal care. The selection of appropriate and supportive feeding interventions begins with a comprehensive assessment of the infant's skills.
Purpose: This study aimed to adapt the Infant-Driven Feeding Scales© (IDFS) to the Turkish language.
Methods: This was a methodological, observational, single-center cross-sectional study. The study included 80 infants born at a gestational age ≥ 32 weeks, consecutively admitted to a tertiary Neonatal Intensive Care Unit (NICU). Research data were collected using a premature infant descriptive information form (IDIF), IDFS, and LATCH Score for Breastfeeding Assessment. For the Turkish validity-reliability of the IDF, the translate-back translate method was used with the content validity index (CVI) assessed.
Results: The scale had CVI values between 0.90 and 1.00 with a mean CVI = 0.96. For measures 1 and 2, there were significant positive and high-level correlations between IFDS-R and IFDS-Q correlation values (r = 0.553–0.958; p = 0.001) and significant negative, low-level correlations between IFDS-R and IFDS-Q with the LATCH scale (r = 0.439–0.532; p = 0.001). According to inter-observer compatibility analyses, the kappa value was 0.94–1.00 for the first measure and 0.96–1.00 for the second measure (p = 0.001). There were negative significant correlations between IDFS-R points with gestational age and postmenstrual age (PMA) (p = 0.001), and gestational age and PMA were explanatory factors for 13.8% of IDFS-R points (F = 7.30, p = 0.001).
Conclusions: The IDFS is recommended for use as a valid and reliable tool to ease the safe and successful development of oral feeding skills in preterm infants and to plan evidence-based interventions.
Implications for practice: The IDFS appears to be a beneficial measurement device for use in assessing the state of readiness of preterm infants for oral feeding and for early determination of risks that may occur due to delayed feeding independence of infants.

Introduction

In recent years, significant increases in the importance given to developing and protecting maternal-infant health, technological developments, and the use of this technology in neonatal intensive care units (NICU) have increased the chances of survival for preterm infants (Blencowe et al., 2013). Though success was achieved in reducing the mortality rates for preterm infants, the same success has not been achieved for the duration of stay of these infants in the NICU (Daicampi et al., 2019). Oral feeding problems, a developmental problem in neonates, are an important topic lengthening duration of hospitalization and increasing health care costs (Bakewell-Sachs et al., 2009; Jadcherla et al., 2010). Ensuring early discharge comprises a focal point in preterm infant care and the infant must acquire the desired functional skills before discharge (Daicampi et al., 2019). These functional skills are defined by the American Academy of Pediatrics (AAP) as good physiological status, regular body weight increase, and the ability of the infant to feed orally (AAP, 2008). Successful oral feeding is one of the most complicated and important tasks that must be achieved before discharging preterm infants (Browne & Ross, 2011; Hwang et al., 2013). The most important factors making the feeding of preterm neonates more difficult are the inability to coordinate sucking-swallowing and respiration, inadequate maturity of the gastrointestinal system, being born between 24 and 36 weeks when the growth rate is highest, and very poor nutrient storage (Bache et al., 2014; Browne & Ross, 2011; Giannì et al., 2015; Hwang et al., 2013).

Neurodevelopmental maturity has critical importance for the oral feeding behavior of premature infants. Oral feeding behavior emerges as a result of the interaction of many systems related to oral feeding skills (Kish, 2013). These systems include oral-motor, neurological,

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cardiorespiratory, and gastrointestinal systems. Interaction between these systems ensures regulation of sucking, swallowing, and respiration of the infant and coordination between these functions. It helps if the infant has sufficient sucking power to meet nutritional needs and breathes with sufficient depth and rate to prevent negative effects on physiological values during feeding (Kish, 2013; Park et al., 2015).

Limited pulmonary function observed in preterm infants born before the 31st week of gestation causes feeding problems to be experienced by preventing the infant's ability to organize pulmonary functions (Dodrill et al., 2008; Pickler et al., 2009). If these infants cannot ensure organization between systems, it may disrupt physiological stabilization (Gewolb & Vice, 2006; Mizuno et al., 2007), reduced sucking activity (Mizuno et al., 2007), disruption of coordination between swallowing and respiration (Gewolb & Vice, 2006), inadequate nutritional intake (Mizuno et al., 2007) and lengthened transition to full oral feeding (Park et al., 2015). Again, for feeding management of premature infants in the NICU, infant weight and pregnancy week are noted rather than the feeding behavior displayed by the infant (Davidson et al., 2013; Shaker, 2013).

This approach is not consistent with the complexity of safe oral feeding implementations for preterm infants, because oral feeding of preterm infants may cause the development of severe complications. For this reason, a careful and educated caregiver, effective and consistent interactions, safe practices, and documentation are required (Waitzman et al., 2014). Traditional oral feeding practices do not include neuroprotective and neurodevelopmental care principles like individualized assessment or age-appropriate education. In traditional practice, feeding problems may be observed due to a personnel-focused and volume-focused approach coming to the fore instead of an infant-focused approach. Unresolved feeding problems may cause growth and developmental delays by continuing after the infants are discharged (Giannì et al., 2015; Howe et al., 2008; White-Traut et al., 2013). For this reason, feeding implementations should be developed for preterm infants in the transition process to oral feeding. However, these implementations may be different between institutions and even within the same intensive care unit as a result of differences in individual approaches.

The Infant-Driven Feeding Scales© (IDFS) was developed by Ludwig and Waitzman in 2007 to remove these individual differences. The first published form of the IDFS comprised three scales ensuring a standard format for documentation used to assess whether premature infants were ready for oral feeding, to measure the quality of feeding performance, and to guide feeding (Ludwig & Waitzman, 2007). These scales were designed for medically stable infants in the 33rd week of gestation. This scale explains caregiving techniques appropriate for use in the NICU and excludes a range of traditional caregiving habits frequently observed in intensive care units. For this reason, it is recommended as a beneficial tool for implementing of an infant-driven feeding scale based on a 'cue-based' feeding approach (Waitzman et al., 2014). In this study, the aim was to research the implementation of the IDFS scales in a tertiary NICU in Turkey.

Methods

Study design and participants

The study was conducted to test the psychometric properties of the Turkish version of the Infant-Driven Feeding Scales© (IDFS) (Waitzman et al., 2014). The secondary and tertiary aims of the study were to determine factors that affect the time the infant takes to achieve full feeding and the time to discharge. This was a methodological, prospective, observational, single-center cross-sectional study. The universe of the study consisted of preterm infants who were treated in the NICU where the study was conducted between January 2019 and February 2020. The study included 80 infants born at a gestational age ≥ 32 weeks, consecutively admitted to a tertiary Neonatal Intensive Care Unit (NICU). Infants monitored in the NICU and abiding the inclusion selection were chosen for the study's sample. In validity-reliability studies, the sample size is recommended to be at least five times and at most ten times the number of items on the scale (Esin, 2014; Tavsancil, 2002). Based on this principle, the research included 80 infants.

The research was completed in the NICU in Giresun Gynaecology and Pediatrics Training and Research Hospital. The unit comprises three levels according to the treatment needs of infants and has the capacity for 18 incubators. To begin the first oral feeding of infants in the NICU, the postmenstrual age (PMA) in weeks is noted, and the decision to begin oral feeding is made by the neonatal specialist doctor and nurse together. There is no written protocol about beginning oral feeding or continuing feeding for preterm infants in the unit. IFDS used an algorithm developed to decide when an infant is ready to start oral feeding and how oral feeding can progress (Fig. 1) (Gelfer et al., 2015).

Selection criteria

Infants chosen for this research:

1. Were born between 32 and 34 weeks gestation;
2. Physically measured consistent with gestational age (using the Fenton growth curve revised by Fanton & Kim, 2013);
3. Had 1st and 5th minute APGAR scores above 4;
4. Were without congenital anomaly or severe complications;
5. Had been stable for 48 h or more since mechanical ventilation or continuous positive air pressure (CPAP) or both supports;
6. Were without intraventricular hemorrhage;
7. Could feed enterally; and.
8. Completed the first 24 h in the transition with an orogastric tube to oral feeding.

Exclusion criteria

Infants were excluded from the study if they:

1. Were born >35 weeks gestation;
2. Had low birth weight according to gestational week;
3. Had severe asphyxia;
4. Born with cleft lip and/or palate;
5. Suffered with any gastrointestinal, neurological, and genetic disease (necrotizing enterocolitis, periventricular leukomalacia, hydrocephalus, Down syndrome, omphalocele, gastroschisis, short intestine syndrome, etc.); or.
6. Had ongoing sepsis with positive blood cultures at the time of the study.

Data collection tool

Premature Infant Descriptive Information Form (IDIF). This form was prepared by the researchers in line with the literature (Bandara et al., 2012; Lau & Smith, 2012; Maggio et al., 2012) and included demographics about the premature infant including sex, gestational age, birth weight, height, head circumference, hospitalization duration, and PMA. Gestational age was based on the date of the last menstrual period and early ultrasound examination.

Premature Infant Feeding Monitoring Form (PIFMF). This was a monitoring form prepared by the researchers in line with the literature (Bandara et al., 2012; Lau & Smith, 2012; Maggio et al., 2012) to monitor premature infants from the time they begin oral feeding. This form includes the first oral feeding time, feeding amount, nutritional amount ordered, and nutritional success of the infant. Feeding data include PMA at the time of beginning oral feeding (defined as consuming at least 5 mL milk from the breast or bottle directly within 24 h) and PMA at the time of feeding independence (100% milk volume obtained from breast or bottle during 24 h). Additionally, the type of feeding (direct breastfeeding, only bottle, or a mix of both) and feeding status (only breast milk, breast milk + formula, and only formula) were recorded on this form (Johnston et al., 2012).

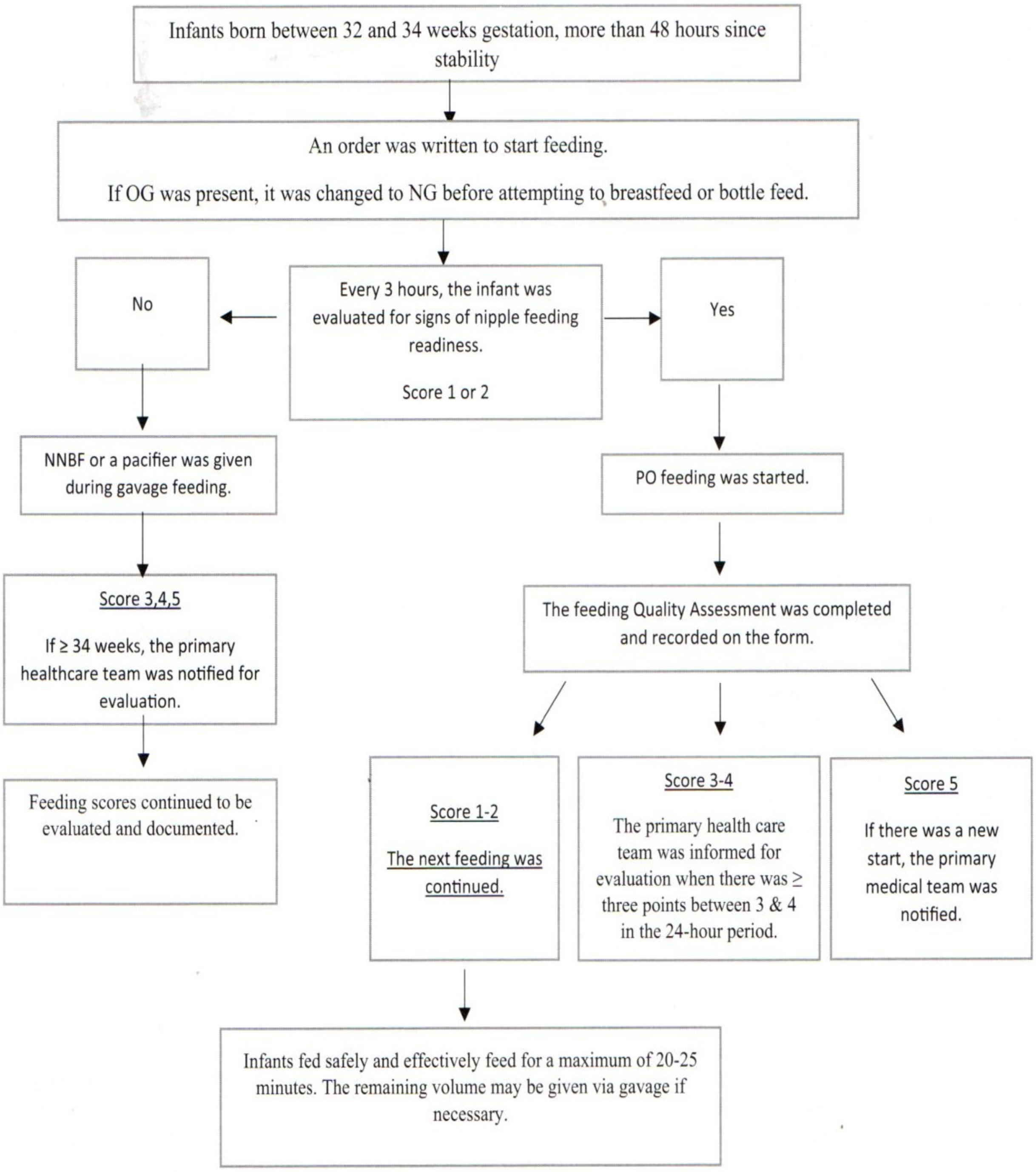

Fig. 1. Algorithm for infant driven feeding.

Infant-Driven Feeding Scales (IDF). This comprises three scales used to measure feeding quality and to meet the need for a feeding intervention guide of preterm infants preparing for oral feeding (Waitzman et al., 2014). It was designed for infants of 33 gestational weeks and stable medical status. The IDF Readiness (IDFS-R) scale is a numerical 5-point scale whereby 1 or 2 points describe feeding readiness behaviors that may lead to oral feeding (breast or bottle), and 3–5 points indicate behaviors and factors that lead to tube feeding. The IDF Quality (IDFS-Q) scale is a 5-point numerical scale defining a range of special feeding behaviors and factors observed when infants begin oral feeding. Receiving 5 points on both the IDFS-R and IDFS-Q scales automatically shows that the infant is not clinically stable, and the caregiver's attention is drawn to the topic of oral feeding safety. Caregiver techniques are organized with letters from A to E to provide support to caregivers. These categories are designed as a communication method between caregivers. This differentiation is used to emphasize caregiver behaviors (supportive techniques) during feeding about infant behaviors.

LATCH Breastfeeding Charting System and Documentation Tool. The LATCH Breastfeeding Charting System and Documentation Tool were developed in Oregon by Jensen and Wallace in 1993. LATCH is a diagnostic tool like the APGAR scoring system in terms of the rating method. The LATCH breastfeeding assessment form comprises five assessment criteria. LATCH is formed by the initial letters of the English words for these five criteria and is listed below:

L: Latch on breast, A: Audible swallowing, T: Type of nipple, C: Comfort of breast/nipple; and H: Hold/help with infant positioning. Each item is assessed with 0–2 points. The lowest points that can be obtained from the scale are 0 with the highest points of 10. High points show the infant's sucking success. In the Turkish validity study for the LATCH Breastfeeding Charting System and Documentation Tool, the Cronbach alpha coefficient was reported to be 0.95 by Yenal and Okumuş (2003).

Data collection/procedure

The premature infant feeding assessment begins with a flow scheme, and this allows the primary nurse to assess whether the infant was prepared for nipple feeding (NF) before feeding begins. The flow scheme comprises two different assessment scales. The first is 'readiness points' (interval 1–5) assessing signs of an infant being ready for nipple feeding every three hours as a part of care. Nurses begin the readiness points table from 32 weeks postmenstrual age; however, an infant continues feeding until PMA of at least 33 weeks and readiness points are 1–2 for at least a half day for 1–2 days. Following NF, the nurse determines quality points (interval 1–5). Infants fed safely and effectively (1–2 points) feed for a maximum of 20–25 min. The remaining volume may be given via gavage if necessary.

If an infant initially sucks well, then tires or loses coordination, feeding is stopped, and the remainder is given via gavage. The amount of milk consumed orally and/or by gavage and the caregiving techniques (e.g., lying on the side, pacing, oral stimulation) are assessed. Data related to the feeding of premature infants is recorded on the relevant form and monitored. Additionally, before the first feed of each day (09.00 am feed), the infant is weighed, and daily body weight is monitored. In line with points obtained from the scales, the transition to breastfeeding is decided. Infants beginning breastfeeding have their first experience assessed with the IDFS-Q and breastfeeding continues. The breastfeeding success of neonates is assessed with LATCH. The infant's breastfeeding skill was assessed with LATCH by the researcher on the first attempt (first measure) and 24 h after the first attempt (second measure).

Ethical statement

Firstly, permission was obtained for the adaptation of the scale to Turkish by email from Waitzman who developed the IDF. Before collecting research data, permission was granted by Giresun University Faculty of Medicine Clinical Research Ethics committee and Giresun Provincial Directorate of Health. Parents of neonates abiding by the sample selection criteria were interviewed, given information about the study, and told they could leave the study at any time, that information would be kept confidential, and the data collected would only be used for the research. Parents who wished to participate in the research provided oral and written consent. In the study, the ethical principles of "Informed Consent Policy", "Volunteer Policy" and "Privacy Protection Policy" were fulfilled since the use of human subjects requires the protection of individual rights.

Statistical analysis

Data were analysed with SPSS 25 statistical program. When analysing study data, descriptive statistics of number, percentage, and arithmetic mean were used. In the research, content validity was calculated with the content validity index. Reliability studies for the scale used kappa analysis for inter-observer consistency and correlation tests between scales for simultaneous-parallel scale validity. Determination of factors explaining IDFS-R and IDFS-Q points used multiple regression analysis.

Results

Characteristics of neonates included in the research are given in Table 1. Of neonates, 51.2% were premature with the mean gestational age of 33.11 ± 1.48 weeks, the mean body weight of 2093.75 ± 589.259 g, the postmenstrual mean age of 35.22 ± 1.12 days, and all were born by caesarean. Of infants, 51.2% were fed with breastmilk, with mean PMA at initial oral feeding at 33.6 ± 1.41 (33.2–35.0) weeks, and mean independent feeding reached at 35.7 ± 1.78 (33.9–39.0) weeks. Of discharged infants, 87.5% were fed only with breastmilk, while 12.5% were fed with breastmilk and formula (See Table 1).

Linguistic validity

Translation of IDFS adaptation means adapting the items according to culture. In this study, permission was received by e-mail from Waitzman et al. (2014) to adapt the IDFS to Turkish and use it. The IDFS was translated into Turkish by three independent bilingual language experts. After it was translated into Turkish, the translated version of the IDFS was reviewed by the research team. Then, the revised version was checked by a Turkish language expert. A different language expert backtranslated the IDFS (Esin, 2014; Tavsancil, 2002).

Table 1
Demographic and clinical characteristics of infants ($N = 80$).

Characteristics	Mean (SD)* (Ranges)
Gestational Age (GA), wk	33.11 ± 1.48 (32–36)
Post menstrual age (PMA), wk	35.22 ± 1.12 (34–36)
Birth Weight (gr)	2093.75 ± 589.259 (1800.40–3100.00)
Birth Height (cm)	44.01 ± 4.02 (37–50)
Birth Head Circumference (cm)	31.62 ± 3.35 (28–44)
Apgar Score 1	7.38 ± 0.92 (5–9)
Apgar Score 5	8.21 ± 0.89 (5–9)
Enteral feeding (days)	9.67 ± 8.36 (3–16)
Length of stay (days)	25.80 ± 10.30 (10–36)
Weight at discharge (gr)	2444.68 ± 423.86 (2380.00–3450.00)
Gender	**N (%)**
Girl	39 (48.75)
Boy	41 (51.25)
Morbidities	
Prematurity (<37-wk GA)	49 (61.25)
Hypoglycemia	19 (23.75)
Transient Tachypnea of the Newborn (TTN)	9 (11.25)
Respiratory Distress Syndrome (RDS)	3 (3.75)
Nutrient content	
Breastmilk	41 (51.25)
Breastmilk + Formula	38 (47.50)
Formula	1 (1.25)
Feeding status	
Parenteral	9 (11.25)
Enteral + Parenteral	71 (88.75)
Discharged fed	
Breastmilk	70 (87.50)
Breastmilk + Formula	10 (12.50)
Initial oral feeding PMA	33.6 ± 1.41 (33.2–35.0)
Independent feeding reached PMA	35.7 ± 1.78 (33.9–39.0)

* SD (Standard Deviation).

Content validity of IFDS

Opinions about the Turkish translation of the scale were obtained from a total of eight experts including a pediatric doctor, lecturer in pediatric nursing, experts acting as trainers in courses related to individualized developmental care of neonates, or who participated in these courses performing academic studies about neonates. Expert opinions were assessed with the Davis technique. Scale items were revised in line with recommendations. The CVI values for the scale should be between 0.90 and 1.00. The CVI was found to be 0.96 (DeVellis, 2012; Jonhson & Christensen, 2014). After the final version of the scale was created, it was applied to 5 neonates not included within the scope of the study and seen to be understandable. Construct validity could not be performed due to the varied scoring between IDFS-R 1–5 and IDFS-Q 1–5 points.

Reliability analyses

The mean IDFS-R points were 1.56 ± 0.65, and mean IDFS-Q points were 1.78 ± 0.65. The mean IDFS-R points, when filled by parents were 2.0 ± 0.1, while the mean IDFS-R points when completed by the researchers were 2.1 ± 0.1. As both scales include a single scoring, reliability coefficients and item-total correlations could not be calculated.

Parallel form reliability test analysis

In the research, LATCH was used as a parallel form. The IDFS-R, IDFS-Q, and LATCH scales were assessed 2 times by two nurses for each infant. Parallel form equivalent results can be seen in Table 2. The correlation between points received by neonates on IDFS-Q and IDFS-R scales is given in Table 2. For measures 1 and 2, there were significant positive high levels of correlation between IDFS-R and IDFS-Q correlation values ($r = 0.553–0.958$; $p = 0.001$), while there were significant negative low-level correlations between IDFS-R and IDFS-Q with the LATCH scale ($r = 0.439–0.532$; $p = 0.001$). (R-value intervals 0–0.49.9: low, 0.50–0.74.9: moderate, 0.75–1.00: high.)

Inter-observer agreement reliability

The kappa coefficient was calculated to assess the inter-observer compatibility of the scale. Additionally, the intraclass correlation coefficient (ICC) was calculated to assess compatibility between observers. According to inter-observer compatibility analyses, the kappa value was 0.94–1.00 for the first measure and 0.96–1.00 for the second measure ($p = 0.001$). When the intraclass correlation coefficient is investigated, the value was 1.00 for the first measure and 0.96–1.00 for the second measure ($p = 0.001$).

Regression analysis

Regression analysis was performed to determine the factors affecting IDFS-R and IDFS-Q points of neonates and the results are presented in Table 3. According to multiple regression analysis, the prediction status of neonate gestational age and PMA for IDFS-R and IDFS-Q points were investigated. There were significant correlations between IDFS-R points with gestational age and PMA ($p = 0.001$), with gestational age and PMA found to be factors explaining 13.8% of IDFS-R points ($F = 7.30$, $p = 0.001$). Also, there were significant correlations between IDFS-Q points with gestational age and PMA ($p = 0.001$), with gestational age and PMA found to be factors explaining 8% of IDFS-Q points ($F = 4.45$, $p = 0.015$) (Table 3).

Discussion

The IDFS® was developed within the scope of the Infant-Driven Feeding® (IDF) practice model. It is a comprehensive tool ensuring the assessment of oral feeding with the neurodevelopmental approach. The IDF practice model ensures consistent critical-decision flow based on infant-focused care supporting individualized development. The IDFS additionally provides a standard format for evidence-based documentation in the assessment of feeding skills and preparation for discharge of infants by all health professionals (Ludwig & Waitzman, 2007; Waitzman et al., 2014). In general, the IDFS was developed to simplify and objectify documentation, develop infant feeding behavior of caregivers, ensure consistency in feeding practice, and assure caregiver awareness related to feeding success, quality, skill development, and safety of neonates. The scales may be used to guide caregivers based on the behavior of the infant. In other words, rather than feeding being limited to age, weight or other physiological parameters, it is based more on the observed behavior and stability of the infant (Waitzman et al., 2014).

Table 3
Logistic regression analysis explaining the IDFS-R and IDFS-Q scores of newborns.

IDFS-R*	B	SE	β	t	p	*Adj R²*	F	(p)
Constant	9.252	2.96		4.21	0.000	0.138	7.30	**(0.001)**
Gestational Age	−0.03	0.09	−0.07	−0.32	0.749			
Post menstrual age	−0.19	0.12	−0.33	−1.51	0.134			
IDFS-Q**	**B**	**SE**	**β**	**t**	**p**	***Adj R²***	**F**	**(p)**
Constant	6.245	2.25		2.76	0.000	0.080	4.45	**(0.015)**
Gestational Age	−0.14	0.09	−0.33	−1.47	0.145			
Post menstrual age	0.10	0.13	0.17	0.07	0.940			

Predictors: (constant), Gestational Age, wk., Post menstrual age, wk.
* Dependent variable: IDFS-R. R: 0.400 R2:0.160 Durbin-Watson: 1.806.
** Dependent variable: IDFS-Q. R: 0.322 R2:0.104 Durbin-Watson: 1.489.

In this study, the validity and reliability of the Turkish version of the IDFS were determined. For the linguistic validity of the IDFS, the translation-back translation method was applied. The most frequently used method for the validity of scale tools is content validity (Crestani et al., 2017). The Turkish content validity of the IDFS was confirmed by eight health professionals with knowledge of neonatal feeding and with comprehensive professional and research experience in oral feeding of infants. The CVI values for IFDS items varied from 0.90 to 1.00 with CVI found to be 0.96. Experts concluded that the content was appropriate and adequate for the purpose. The CVI for the IDFS-Turkish was above the accepted threshold of 0.80 (Polit & Beck, 2006).

To assess the parallel form validity of the IDFS, the LATCH breastfeeding diagnostic form was chosen as a confirmation criterion. Parallel form validity assesses the consistency between the developed scale and another previously developed scale with the same purpose. The two scales are applied to the same group and the correlation coefficient between the points is calculated (Esin, 2014; Gözüm & Aksayan, 2003). In the research, there were significantly negative and low-level correlations between the IDFS-R and IDFS-Q with the LATCH scale ($r = 0.439–0.532$; $p = 0.001$) (Table 3). A similar study by Thoyre et al. (2018) used the IDFS-Q for construct validity in the validity and reliability analysis of the Early Feeding Skills (EFS) tool they developed to assess the early feeding skills of neonates. Assessment of the total IDFS-Q points determined that the EFS scale had construct validity ($r = -0.73$; $p < 0.01$).

In research where data are collected by observations and include more than one observer, the compatibility between independent observers is one of the features examined when determining the reliability

Table 2
Correlation of IDFS-R, IDFS-Q and LATCH scales.

Variable	IDFS-R*	IDFS-Q**	IDFS-R*	IDFS-Q**	LATCH*	LATCH**
IDFS-R*	1					
IDFS-Q*	r = 0.553 p = 0.000	1				
IDFS-R**	r = 0.956 p = 0.000	r = 0.598 p = 0.000*	1			
IDFS-Q**	r = 0.531** p = 0.000	r = 0.958 p = 0.000*	r = 0.571 p = 0.000	1		
LATCH*	r = −0.532 p = 0.000	r = −0.488 p = 0.000	r = −0.552 p = 0.000	r = −0.440 p = 0.000	1	
LATCH**	r = −0.535 p = 0.000	r = −0.491 p = 0.000	r = −0.552 p = 0.000	r = − 0.439 p = 0.000	r = 0.981 p = 0.000	1

*first observation **second observation.

of scales. The closer the observation results of independent observers, the more reliable the scale is (Balcı, 2015; Esin, 2014). The kappa coefficient was calculated with the aim of testing compatibility between observers in the research. If the kappa coefficient is between 0.93 and 1.00 it shows the perfect level of compatibility, 0.81–0.92 is very good compatibility, 0.61–0.80 is good compatibility, 0.41–0.60 is moderate compatibility, 0.21–0.40 is below average compatibility and 0.1–0.20 is weak compatibility (Çam & Baysan-Arabacı, 2010; Gözükara Bağ et al., 2010). In our study, the kappa value based on inter-observer compatibility analysis was 0.94–1.00 for the first assessment and 0.96–1.00 for the second assessment ($p = 0.001$).

Due to the form of scoring in the IDFS, item-total correlations and Cronbach alpha coefficients could not be calculated. Validity studies are performed for scales developed with this type of scoring; however, it appears reliability studies cannot be performed due to the type of scoring (Ersig et al., 2013). With multiple regression analysis, the prediction status of gestational age and PMA of neonates for IDFS-R and IDFS-Q points were investigated. The IDFS-R points of neonates had negative significant correlations with gestational age and PMA ($p = 0.001$), with gestational age and PMA being the factors explaining 13.8% ($F = 7.30, p < 0.001$) of IDFS-R points (Table 3). Previous studies reported that some preterm infants were ready for feeding at 29–30 weeks PMA (Gennattasio et al., 2015; Nyqvist, 2008). Additionally, it was reported that readiness for feeding was associated more with pregnancy week at birth rather than PMA. Amaizu et al. (2008) researched the changes over time of certain feeding skills reflecting the progression of feeding performance and reported that the maturation indexes for certain oral feeding skills were linked to pregnancy age more than PMA. The results of the study by Giannì et al. (2017) showed that the median scores obtained at subsequent assessments using the Infant Driven Scale progressively increased, suggesting individual neurodevelopmental maturation of infants. Specifically, a score ≤ 8 at assessment performed at 32 weeks PMA was associated with a delay of 1.8 weeks in achieving feeding independence. These findings support our study. Though infants mature at different rates, previous research proposed that the necessary coordination of reflexes, sucking, swallowing and breathing skills begin in the 33rd week of pregnancy (Bakewell-Sachs et al., 2009; Barlow, 2009; Laptook, 2013; Sahni & Polin, 2013). For this reason, in this feeding method, initial assessments of feeding readiness begin, and assessments continue before every feeding experience after the 33rd pregnancy week. Also, further study of individual feeding skills development using the IDFS would add to our understanding of neonatal feeding skill development. Understanding the evolution of feeding skill development for preterm infants as well as the term-age infants commonly treated in the neonatal intensive care department or unit (Thoyre et al., 2018).

When infant oral feeding begins, the clinician assesses the quality of feeding assessment and the infant using the required caregiver support type for a safe feeding experience (Ludwig & Waitzman, 2007). Consistent with previous studies (Ludwig & Waitzman, 2007; Newland et al., 2013; Wellington & Perlman, 2015), this study shows, that IDFS implementation in the NICU appears to be a beneficial tool to assess the readiness of infants for oral feeding and monitor progress in the context of a cue-based oral feeding approach. Additionally, the IDFS is thought to provide the opportunity for early detection of infants at risk of delay in obtaining feeding independence (Gennattasio et al., 2015).

Practice implications

Determination of readiness for oral feeding of premature infants is complicated. For this reason, assessment of the feeding skills of preterm infants with the IDFS guides decisions about delaying oral feeding which is beyond their capacity. In this situation, avoiding negative feeding experiences may protect the infant's oral feeding ability when oral feeding skills are present. In this context, the assessment may be an important component in preventing long-term feeding problems. However, untreated feeding disorders have been shown to be persistent over time and have long-lasting consequences for the motor and cognitive development of the child (Wilken & Bartmann, 2014; Wolke et al., 2009). For infants who can feed orally, the IDFS provides a reliable and valid route to systematically observe and record the maturation of feeding skills. It guides the selection of interventions to support feeding skills in the best way possible.

Feeding skills are expected to change over time as the infant's bodily systems mature and improve. For this reason, there is a need to assess the variation in skills over time. Clinicians need valid and reliable tools to organize data and develop a common language to assess and define individual feeding skills. The IDFS offers an effective path to assess the progression of infant feeding skills.

Limitations

This study has some limitations. Caregivers have a responsibility to recognize factors that might impact the introduction or progression of oral feeding. Feeding readiness assessment should be included in the skills development required by all bedside clinicians. Replication of this study with a large sample size is recommended. Finally, this is a single-center study and findings cannot be generalized to the general population. However, as this was a single-center study, findings were not affected by inconsistent NICU feeding guidelines.

Conclusions

In conclusion, the Turkish version of the IDFS is a valid and reliable tool that can be used in the NICU to assess feeding skills in the transition to oral feeding of preterm infants. Additionally, the IDFS allows the opportunity to regulate feeding interventions in problematic areas during the transition to oral feeding. For this reason, the IDFS is recommended for use in easing the safe and successful development of oral feeding skills in preterm infants and planning evidence-based interventions.

The IDFS appears to be a beneficial tool for assessing the readiness for oral feeding of preterm infants and early determination of infants at risk of delayed feeding independence. This study shows the IDFS is an appropriate complementary assessment tool that can be easily used by health professionals in clinical practice.

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Author contributions

All authors made substantial contributions to the conception and design of the study and the acquisition and interpretation of the data. All the authors drafted the article or critically revised it for intellectual content.

Ethical considerations

The ethics committee approval was received from Giresun University Scientific Research Ethics Committee and legal permissions were received from the institutions where the research will be conducted.

Declaration of Competing Interest

The authors declare that they have no conflict of interests.

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