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RESEARCH PAPER (ORIGINAL)

Validation of the Early Feeding Skills Assessment Scale for the Portuguese population

Validação para a população portuguesa da Escala de Observação de Competências Precoces na Alimentação Oral

Validación para la poblaciónportuguesa de la Escala de Observación de las HabilidadesTempranasen la Alimentación Oral

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Abstract

Background: The decision to introduce oral feeding (breast/bottle-feeding) in preterm infants is based on their weight, gestational age, physiological stability, and health status. Although the assessment based on these assumptions has been a clear asset, it has not always met preterm infants' individual needs. Some instruments allow determining the adequate moment to begin oral feeding as well as monitoring the infantduring this process.

Objectives: To perform the cultural adaptation and psychometric validation of the Early Feeding Skills Assessment,modified version (Early Feeding Skills Assessment, versãomodificada - EFS-VM).

Methodology: Quantitative study with a sample of 698 newborns with a gestational age ≥24 and<37. Confirmatory factor analysis and Cronbach's alpha were used to assess the factorial validity and reliability of the model.

Results: The EFS-VM presented adequate factorial validity, ($\chi^2(186)=913.206$; $p<.001$, $n=698$; $\chi^2/df=4.91$; CFI=.903; TLI=.890; RMSEA=.075; P[rmsea≤.05]<.001).

Conclusion: EFS-VM is a sensitive, valid, and reliable tool to observe newborns' early feeding skills; it facilitates the adjustment of the care plan, and allows developing interventions in partnership with families.

Keywords: validation studies; infant, newborn; breastfeeding; bottle-feeding

Resumo

Enquadramento: A introdução da alimentação oral (mama/tetina) no recém-nascido (RN) pré-termo baseia-se no peso, idade gestacional, estabilidade fisiológica e estado de saúde. É evidente que a avaliação através destes pressupostos tem sido uma mais-valia, porém nem sempre responde às necessidades individuais do RN. Existem instrumentos que permitem avaliar o momento adequado para o início da alimentação bem como o desempenho da criança durante o processo.

Objetivos: Fazer a adaptação cultural e a avaliação das qualidades psicométrica da *Early Feeding Skills Assessment Scale,* versão modificada (EFS-VM).

Metodologia: Estudo quantitativo, numa amostra de 698 RN, idade gestacional ≥24 e <37. A validade fatorial do modelo e a fiabilidade foi avaliada com uma análise fatorial confirmatória e o alfa de Cronbach.

Resultados: A EFS-VM apresentou uma adequada validade fatorial, ($\chi^2(186)=913,206$; $p<0,001$; $n=698$; $\chi^2/df=4,91$; CFI=0,903; TLI=0,890; RMSEA=0,075; P[rmsea≤0,05]<0,001).

Conclusões: EFS-VM é um instrumento sensível, válido e fiável para observar as competências precoces do RN durante o processo de alimentação, facilita o ajustamento do plano de cuidados e permite desenvolver intervenções em parceria com as famílias.

Palavras-chave: estudos de validação; recém-nascido; aleitamento materno; alimentação artificial

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Resumen

Marco contextual: La introducción de la alimentación oral (pecho/tetina) en los recién nacidos (RN) prematuros se basa en el peso, la edad gestacional, la estabilidad fisiológica y el estado de salud. La evaluación a través de estos parámetros resulta muy útil, pero no siempre responde a las necesidades de cada RN. Existen herramientas para determinar el momento adecuado para comenzar con la alimentación oral, así como el rendimiento del niño.

Objetivos: Realizar la adaptación cultural y evaluación de las cualidades psicométricas de la *Early Feeding Skills Assessment* versión modificada (EFS-VM).

Metodología: Estudio cuantitativo en una muestra de 698 RN, edad gestacional ≥24 y <37. La validez factorial del modelo y la fiabilidad se evaluó con un análisis factorial confirmatorio y el alfa de Cronbach.

Resultados: La EFS-VM presenta una adecuada validez factorial, ($\chi^2(186)=913,206$; $p<0,001$; $n=698$; $\chi^2/df=4,91$; CFI=0,903; TLI=0,890; RMSEA=0,075; P[rmsea≤0,05]<0,001).

Conclusión: La EFS-VM es una herramienta sensible, válida y fiable para observar las competencias precoces del RN durante la alimentación oral, facilita el ajuste del plan de atención y permite intervenir en colaboración con las familias.

Palabras clave: estudios de validación; recién nacido; lactancia materna; alimentación artificial

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Introduction

Oral feeding (e.g., breast or bottle-feeding) is one of the most complex interventions in care delivery to infants and more specifically to preterm infants; however, healthcare team members sometimes do not recognize it as such. Although this intervention should be performed by experienced nurses, it is often delegated to less experienced nurses, as it is considered an instinctive action between the infant and the caregiver. In practice, the infant is usually blamed for an unsuccessful feeding, and this prejudice often extends to parents, who are supposed to be naturally competent in this area of care. Many mothers assess their parenting ability based on their ability to feed their infant successfully and/or on the infant's daily weight gain; in fact, this is one of the most frequently asked questions by the family in neonatal intensive care units (NICUs). McGrath (2014) emphasizes the importance of family-centered care in order for health professionals to promote parenting by creating opportunities for parents to use the skills and competencies acquired and develop new ones, according to the newborn's needs. Recognition and respect for the family's skills are essential for health professionals to establish a true care partnership.

The environment at NICUs does not facilitate the bonding process, the development of parenting skills or even the development of these children, so the implementation of intervention strategies becomes a priority for the team to reduce hospital length-of-stay. One of the most important interventions consists in achieving autonomy in feeding.

In this sense, the nurse's intervention in the introduction of oral feeding of preterm infants becomes one of the most complex interventions of neonatal care. Feeding has to be based on well-defined protocols, supported by well-structured assessment instruments that complement other observations in this process. Therefore, it is important to use instruments that facilitate an objective assessment of preterm infants' skills during the process of feeding (e.g., breast or bottle-feeding) in all meals because the success of oral feeding will positively influence the development and growth of the infant and family in the short- and long-term. A search was conducted to identify an instrument that, once validated, could measure newborns' early feeding skills. After the search, the Early Feeding Skills Assessment Scale (EFS; Thoyre, 2003; Thoyre, Shaker, & Pridham, 2005, 2010) was selected since it allowed for the assessment of early feeding skills and indicated measures to support feeding.

The objective of this study was to perform the cultural adaptation and psychometric validation of EFS-VM.

Background

Due to their physiological (e.g., immaturity, inability to maintain thermoregulation, hypotonia, respiratory and circulatory alterations) and behavioral characteristics (e.g., irritability, hyperactivity, inability to sustain a quiet alert state), preterm infants often have difficulties in oral feeding. The decision to introduce oral feeding (e.g., breast or bottle-feeding) in the preterm infant is not easy and, as such, it should be based "on an evaluation of the infant's developmental maturity, weight, activity level, respiratory status (absence of apnea and adequate oxygen saturation levels), and sucking capabilities" (Askin & Wilson, 2014, p. 345). Thoyre et al. (2005, 2010) further emphasize that the suck-swallow-breathe coordination, the infant's interest in sucking, and the behavioral and organizational skills (e.g., quiet alert state) are decisive factors that facilitate a safe transition and a successful oral feeding.

Sucking and swallowing reflexes are developed in the mother's womb and mature during the third trimester. Sucking involves a rhythmic movement of the tongue and jaw that causes milk to flow out of the bottle teat or nipple due to changes in intraoral pressure (Kenner & McGrath, 2004). The act of pulling and pushing is comprised of a negative pressure (suction) and a positive pressure (compression). Positive pressure creates a rhythmic compression of the nipple between the tongue and the palate, which pushes the milk out of the nipple/bottle teat and into the oral cavity. The rhythmic contraction of the jaw muscles and tongue movements gener-

ates negative pressure or suction (Lau, 2012). Non-nutritive sucking only begins at around 26 weeks, but the rhythmic pattern of sucking only becomes well established between 32 and 34 weeks. So, the establishment of non-nutritive sucking facilitates the development of the sucking reflex (Pinneli & Symington, 2005), which influences the feeding ability and, consequently, the daily weight gain (Harding, 2009). Swallowing is a complex motor activity and has the function of transporting food and liquid from the mouth to the stomach while preventing milk aspiration into the trachea and lungs. The swallowing reflex is fully functional at around 34 weeks, as well as the gag reflex (Kenner & McGrath, 2004; Lau, 2012; Thoyre et al., 2010). However, ineffective swallowing may be related to pharyngoesophageal dysfunctions, which are characterized by decreased muscle tone and relaxation of the esophageal sphincter (Jadcherla et al., 2009). Breathing is an autonomic process, only acknowledged when there is a high respiratory effort. Preterm infants' immature respiratory system hampers respiratory mechanics, increasing the irregularity of respiratory cycles, and, consequently, the risk of aspiration and apnea. Respiratory diseases, particularly bronchopulmonary dysplasia (Vice & Gewolb, 2008) pose an increased risk. Thus, after achieving respiratory stability, acquiring feeding skills is a priority, because, without it, the preterm infant cannot be discharged from the hospital.

Suck-swallow-breathe coordination is perhaps the most difficult task that the infant has to learn during childhood. Some authors consider that all of the infant's physiological components are present at 28 weeks, although mostly immature. The sucking reflex is well developed between 28 and 30 weeks, but the infant gets tired easily. Non-nutritive sucking can be present at 26 weeks, but the swallowing reflex is only fully functional at 34 weeks, although a rhythmic pattern is not always developed (Thoyre et al., 2010). According to McGrath, Medoff-Cooper, Hardy, and Darcy (2010), suck-swallow-breathe coordination may arise between 32 and 34 weeks, for short periods, but it is not enough for the infant to make oral feeding in full. For these authors, it should only be considered mature after 36-38 weeks. In addition to all these aspects, the healthcare professional, namely the nurse, should be able to identify signs of neuro-behavioral maturation before starting oral feeding (breast or bottle-feeding). In according to Als' synactive theory, Kenner and McGrath (2004) considers that neurobehavioral maturation is achieved at 32 weeks of gestation, when the infant's breathing is mostly regular (40 to 60 cycles/minute), and when the infant shows transition from soft stages, behavioral stability (no signs of stress, alert and attentive stage), hunger cues (wakes up to eat, takes hands to mouth, and has cardinal point reflexes), and the ability to deal with the surrounding environment. With regard to motor development, the infant should have regular or strong muscle tone, and be able to maintain the body in a flexed position. In terms of the oral-motor development, the infant should have good facial muscle tone without spending too much energy.

The research carried out by Susan Thoyre and colleagues over the years has emphasized the importance of the infant being able to regulate oxygen saturation, maintain a quiet alert state, and maintain a sucking and swallowing pattern to be able to eat, which is in line with what is observed in clinical practice. This scale was designed to assess preterm infants' feeding skills from birth until 52 weeks of post-conceptional age (Thoyre et al., 2010).

Research question

Does the EFS-VM have adequate psychometric qualities for assessing preterm infants' early feeding skills?

Methodology

The author, Susan Thoyre, authorized the translation and adaptation of the scale to the Portuguese cultural context and language. Three Portuguese translators (bilingual, with expertise in the area of study and in health) translated the original English version into Portuguese, which resulted in three versions of the scale. Then, three English translators

back-translated these three versions. After analysis of these versions, the instrument was adjusted and the semantic equivalence of the items was achieved with the collaboration of the author of the scale. A group of experts (nurses and physicians with experience in neonatology) performed the facial validation of the EFS, which was applied to a group of infants with characteristics similar to those of the population under analysis.

The validation of the scale started with a pre-test on content validity and reproducibility at the neonatology units of two hospitals in the Lisbon area, with a sample of 30 newborn observations. After the pre-test, data were collected for EFS validation. The health professionals who would participate in data collection (2009-2011) received specific training on the application of the scale in the neonatology units. Data collection took place during 19 months, with the support of a website in Google Docs, in which the professionals participating in the study would insert the data using a specific password.

The analysis of the answers to the EFS items showed that there was no missing data, with a zero percentage of non-completed items (non-response), which confirmed that the EFS items were clear and culturally appropriate and adapted. The research process complied with the ethical-legal principles and it was approved by the boards of directors and ethics committees of the hospitals involved and by the legal guardians of the infants observed in the study.

Sample

The sample was composed of 698 observations (the same sample used in the initial study) of bottle-fed infants, with ≥ 24 and < 37 weeks of gestational age, weighing between 1,210 and 4,706 grams, and with an average weight of 2,082 grams. The study participants were selected using a nonprobability convenience sampling technique (Marôco, 2014a). This technique can cause some bias; thus, the findings obtained in the sample need to be carefully generalized to the population. Newborns with intraventricular hemorrhage, central nervous system and orofacial malformations, chromosomopathies, or bronchopulmonary dysplasia were excluded from the study. Sample size was considered appropriate for data analysis, with a ratio of more than 20 participants per scale item (Curado, Teles, & Marôco, 2014; Hair, Black, Babin, Anderson & Tatham, 2006; Kahn, 2006; Marôco, 2014b).

Instrument

The EFS allows making a general and a specific observation of the newborn throughout the feeding process. The posture, the state of alertness, tonicity, and baseline oxygen saturation were assessed immediately before feeding. Feeding tolerance was assessed (general observation) five minutes after feeding. The specific observation is supported by a group of 28 items, using a 3-point ordinal scale, distributed by four dimensions (Thoyre et al., 2010): *Capacidade de se manter interessado na alimentação* (CMIA), with three items; *Capacidade para organizar o funcionamento oro-motor* (COFO), with seven items; Capacidade para coordenar a deglutição (CCD), with six items; and *Capacidade para manter a estabilidade fisiológica* (CMEF), with 12 items. In the first phase of the study (2012-2014), the factor model of the EFS - composed of four dimensions (factors) and 28 items, adjusted to a sample of 698 observations of newborns - had poor goodness-of-fit values (χ^2/df = 23.854; CFI = 0.890; TLI = 0-879, RMSEA = 0.082, P(RMSEA ≤ .05). For this reason, the initial model was refined based on modification indices obtained with Mplus. The following items were removed: items 1, 2 and 3 from the first dimension (which was no longer part of the scale) on the newborn's ability to maintain engagement in feeding (composed of three items); item 14 from the dimension Ability to coordinate swallowing, with six items (which was then composed of five items); and items 27 and 28 from the dimension Ability to maintain physiologic stability, with 12 items (which was then composed of 10 items). These items were removed due to sensitivity issues, high values of asymmetry and kurtosis coefficients ($|g_1| > 3$ and $|g_2| > 7$) and low factor loadings (> .210 and < .40). The final modified scale (EFS-VM) was composed of 22 items.

The EFS-VM consists of three dimensions: *Capacidade para organizar o funcionamento*

oro-motor (COFO), with seven items; *Capacidade para coordenar a deglutição* (CCD), with five items; and *Capacidade para manter a estabilidade fisiológica* (CMEF), with 10 items (Tables 1, 2, and 3). The COFO dimension reflects the maturation of the structures involved in feeding and the neurological ability to coordinate them (Table 1).

Table 1

Descriptors of the dimension Capacidade para organizar o funcionamento oro-motor (COFO)

Capacidade em organizar o funcionamento Oro-Motor			
Itens	Opções de resposta		
1. Abre a boca prontamente quando a mama/tetina toca os lábios no início de cada surto.	2 - Abre a boca prontamente todas as vezes	1 - Abre a boca prontamente algumas vezes	0 - Nunca abre a boca prontamente
2. A língua descai para receber a mama/tetina do biberão no início da alimentação.	2 - A língua descai todas as vezes	1 - A língua descai algumas vezes	0 - A língua nunca descai
3. Imediatamente após a introdução da mama/tetina, a sucção da criança está organizada, rítmica e suave. (A sucção organizada tem um padrão de um surto de sucção – pausa. Na sucção desorganizada a criança trinca ou cerra o maxilar, retrai a língua ou empurra a mama/tetina com a língua).	2 - A sucção está sempre organizada	1 - A sucção está organizada algumas vezes	0 - A sucção nunca está organizada
4. Assim que a alimentação está a decorrer, mantém um padrão de sucção suave e rítmico (ver descrição em cima).	2 - Observa-se estabilidade e consistência	1 - Alguma desorganização da sucção no decurso da mamada	0 - Incapacidade em manter a sucção organizada
5. A pressão da sucção é constante e forte (i.e., chupa com vigor e a um ritmo constante).	2 - Observa-se estabilidade e consistência	1 - Algumas sucções débeis	0 - Sucção frequentemente débil
6. Empenha-se em fazer surtos de sucção prolongados (sete a 10) sem apresentar sinais de *stress* ou instabilidade fisiológica e/ou uma resposta cardiorrespiratória adversa ou negativa (os sinais de *stress* incluem o franzir das sobrancelhas, olhar preocupado, afastamento da mama/tetina, etc.).	2 - Faz sempre surtos de sucção longos sem sinais de *stress*	1 - Alguns surtos de sucção longos sem sinais de *stress*	0 - Sem surtos de sucção longos ou todos os surtos acompanhados de sinais de *stress*
7. A língua mantém contacto constante com a mama/tetina – não desliza da mama/tetina e ao fazer a sucção ouve-se um som de clique.	2 - Sem som de clique	1 - Alguns sons de clique	0 - Sons frequentes de clique

The CCD dimension allows checking if the suck-swallow-breathe coordination is peaceful and safe enough to allow sufficient air to maintain physiological homeostasis during swallowing (moment of apnea whenvocal cords close until swallowing is completed; Table 2).

Table 2

Descriptors of the dimension Capacidade para coordenar a deglutição(CCD)

Capacidade em Coordenar a Deglutição			
Itens	Opções de resposta		
8. Gere os fluidos durante a deglutição sem os perder pelos cantos da boca. (i.e., não se baba).	2 - Sem perda de líquido	1 - Alguma perda de líquido	0 - Frequente perda de líquido
9. Os sons faríngeos são limpos – não se ouve o gorgolejo criado pelo líquido no nariz ou faringe.	2 - Sem sons de gorgolejo	1 - Alguns sons de gorgolejo	0 - Frequentes sons de gorgolejo
10. A deglutição é suave – sem esforço para engolir.	2 - Suaves deglutições	1 - Algumas deglutições com dificuldade	0 - Frequentes deglutições com dificuldade
11. Uma simples deglutição assimila o *bólus* da sucção – Não são necessárias múltiplas deglutições para esvaziar os fluidos para a garganta.	2 - Todas as deglutições são únicas para o mesmo *bólus*	1 - Algumas deglutições múltiplas para o mesmo *bólus*	0 - Frequentes deglutições múltiplas para o mesmo *bólus*
12. Tosse ou sons de engasgamento.	2 - Nenhum evento observado	1 - Pelo menos um evento observado	0 - Dois ou mais eventos observados

The CMEF dimension allows checking physiological signs, including the infant's skin color, oxygen saturation, respiratory and heart rate, as well as sucking bursts (number of feedings between each breath; Table 3).

Table 3

Descriptors of the dimension Capacidade para manter a estabilidade fisiológica(CMEF)

Capacidade em Manter a Estabilidade Fisiológica			
Itens	Opções de resposta		
13. Cerca de 30s depois de iniciar a alimentação a saturação de O_2 estabiliza e não há sinais de ***stress***.	2 - Observa-se estabilidade e consistência	1 - Começam a tornar-se visíveis	0 - Não se observa
14. Interrompe a sucção para respirar. O prestador de cuidados não tem que interromper a mamada para a criança respirar.	2 - Interrompe a sucção para respirar de forma consistente	1 - Começam a emergir algumas capacidades: Interrompe a sucção na maioria das vezes	0 - Não interrompe a sucção por si para respirar
15. Quando interrompe a sucção para respirar, observam-se vários ciclos respiratórios completos.	2 - Faz ciclos respiratórios completos para se equilibrar	1 - Faz ciclos respiratórios completos para se equilibrar na maioria das vezes	0 - Não interrompe a sucção para respirar
16. A criança pára para respirar antes de começar a demonstrar sinais de ***stress***. (sinais de ***stress*** observados incluem: franzir das sobrancelhas, olhar preocupado, afastamento da mama/tetina, etc.).	2 - Pára para respirar antes de surgirem sinais de ***stress***	1 - Frequentemente pára para respirar antes de surgirem sinais de ***stress***	0 - Não pára para respirar antes de surgirem sinais de ***stress***
17. Sons respiratórios limpos – sem roncos (expiração prolongada, glote parcialmente encerrada na expiração).	2 - Sem roncos	1 - Roncos esporádicos	0 - Roncos frequentes
18. Sons respiratórios limpos – sem sinais de estridor que sugerem uma passagem de ar restrita no canal.	2 - Sem estridor	1 - Estridor esporádico	0 - Estridor frequente
19. Adejo nasal e/ou alteração da cor (palidez).	2 - Sem adejo nasal e/ou palidez da asa do nariz	1 - Adejo nasal e/ou palidez da asa do nariz esporádico	0 - Adejo nasal e/ou palidez da asa do nariz frequente
20. Utilização dos músculos acessórios na respiração (e.g., elevação do queixo, cabeça para trás, retração e tiragem).	2 - Nunca há utilização dos músculos acessórios	1 - Utilização dos músculos acessórios esporádica	0 - Utilização dos músculos acessórios frequentemente
21. Alteração da cor durante a alimentação (e.g., palidez e cianose peribocal e/ou periorbital).	2 - Nunca há alteração da cor	1 - Alteração da cor esporádica	0 - Alteração da cor frequente
22. Descida da saturação de O_2 abaixo dos 90%.	2 - Nunca	1 - Ocasional	0 - Frequente

Procedures

Data used to assess the psychometric qualities of the EFS-VM were analyzed using IBM® SPSS® (version 20, SPSS, An IBM Company, Chicago, IL) and Mplus (version 6; Muthén & Muthén, Los Angeles, CA). Item sensitivity was assessed using asymmetry (g_1) and flatness (g_2) coefficients. We established that the items with values ranging between the maximum and minimum of the measurement scale and with low absolute asymmetry and kurtosis values ($g_1 < 3$ and $g_2 < 7$, respectively; Kline, 2004; Marôco, 2014b) had psychometric sensitivity, that is, they had the ability to discriminate structurally different individuals (Marôco, 2014b). Construct validity was assessed using factorial and convergent validity, through the confirmatory factor analysis, with robust weighted least squares (RWLS) estimation for ordinal variables, as implemented in the Mplus software. We established that the model would only be considered valid if all EFS items had factor loadings above the reference value (.40). The model's factorial validity was assessed through a confirmatory factor analysis. The following empirical indices of the EFS model's goodness-of-fit were used: chi-square goodness-of-fit test (χ^2/df) less than 5; Comparative Fit Index (CFI), Goodness of Fit Index (GFI), and Tucker-Lewis Index (TLI) greater than .90; and Root Mean Square Error of Approximation (RMSEA) less than .05. The reliability of the EFS dimensions (factors) was calculated based on the Cronbach's alpha coefficient for the internal consistency of the three dimensions. Reliability was estimated based on the mean EFS inter-item correlations, with weighted variance. Reliability would be acceptable if $\alpha \geq .70$. We also considered a composite reliability (CR) ≥ .70 and an average variance extracted (AVE) ≥ .50 as indicators of convergent validity. Factor discriminant validity was present for factors with an AVE greater than the square of the inter-factor correlation (Marôco, 2014b; Marôco & Garcia-Marques, 2006).

Results

The psychometric qualities of the EFS-VM were assessed based on the estimation of the sensitivity, validity, and reliability of the scale items in the three dimensions using a sample of preterm infants. An item has a high sensitivity when it is able to discriminate structurally different individuals, which can be assessed through descriptive measures. Table 4 presents the statistics of the EFS-VM items: median, maximum, and minimum values, measures of shape (g_1 and g_2), and their critical ratios. Based on this data, we conclude that the EFS-VM items are sensitive. Only items 17 and 18 had some sensitivity problems, possibly because the professionals had more difficulty observing them (identification of breathing sounds).

Table 4

Median, Maximum, Minimum values and measures of shape – asymmetry (g_1) and kurtosis (g_2) – and their critical ratios (g_1/SEg_1; g_2/SEg_2), $SEg_1=0.093$, $SEg_2=0.185$; for the 22 items of the EFS-VM (n=698)

Items and dimensions of the EFS-VM								
Dimension	Items	Me	g_1	g_1/SE_{g1}	g_2	g_2/SE_{g2}	Min	Max
COFO	1	2.00	-0.368	-3.957	-1.420	-7.676	0	2
	2	2.00	-0.679	-7.301	-0.871	-4.708	0	2
	3	2.00	-1.067	-11.473	0.132	0.714	0	2
	4	2.00	-0.705	-7.581	-0.469	-2.535	0	2
	5	2.00	-0.623	-6.699	-0.550	-2.973	0	2
	6	1.00	-0.150	-1.613	-0.514	-2.778	0	2
	7	2.00	-1.508	-16.215	1.265	6.838	0	2

CCD	8	1.50	-0.554	-5.957	-0.615	-3.324	0	2
	9	2.00	-2.142	-23.032	3.764	20.346	0	2
	10	2.00	-1.041	-11.194	0.061	0.330	0	2
	11	2.00	-1.136	-12.215	0.269	1.454	0	2
	12	1.00	-1.568	-16.860	0.458	2.476	0	1
CMEF	13	2.00	-2.581	-27.753	6.130	33.135	0	2
	14	2.00	-1.145	-12.312	0.246	1.330	0	2
	15	2.00	-1.041	-11.194	0.079	0.427	0	2
	16	2.00	-1.022	-10.989	-0.038	-0.205	0	2
	17	2.00	-3.584	-38.538	8.874	47.968	0	2
	18	2.00	-3.007	-32.333	8.640	46.703	0	2
	19	2.00	-1.770	-19.032	2.296	12.411	0	2
	20	2.00	-1.114	-11.978	0.249	1.346	0	2
	21	2.00	-2.433	-26.161	5.299	28.643	0	2
	22	2.00	-1.936	-20.817	2.948	15.935	0	2

Table 5 shows the factor loadings and the Cronbach's alpha value (α) for each EFS-VM dimension. With regard to internal consistency, the COFO (with seven items) and CMEF (with 10 items) dimensions had higher Cronbach's alpha values than those found in the CCD dimension (with five items), which can be related to the fact that this dimension has fewer items.

CR in the three dimensions was CR_{COFO} = .953, CR_{CCD} = .861, and CR_{CMEF} = .951. Convergent validity, estimated based on the AVE, was AVE_{COFO} = .745; AVE_{CCD} = .561, and AVE_{CMEF} = .661. All of the values were higher than the reference values.

Table 5

Factor loadings obtained from confirmatory factor analysis and internal consistency analysis (Cronbach's α) of the three factors of the EFS-VM

	EFS-VM Dimensions		
	AOOF	CCD	CMEF
	α = .795	α = .655	α = .818
EFS-VM Items	Factor loadings		
Item 1	.732		
Item 2	.730		
Item 3	.815		
Item 4	.890		
Item 5	.773		
Item 6	.798		
Item 7	.771		
Item 8		.630	
Item 9		.605	
Item 10		.879	
Item 11		.649	
Item 12		.507	

Item 13	.753
Item 14	.883
Item 15	.770
Item 16	.847
Item 17	.633
Item 18	.614
Item 19	.621
Item 20	.647
Item 21	.726
Item 22	.765

Table 6 shows the average magnitude of the correlation coefficients between the three dimensions. Figure 1 shows the three-factor model of the EFS-VM with their factor loadings and goodness-of-fit indices that support the scale dimensions (factors).

Table 6
Pearson's correlation between the three dimensions of the EFS-VM

	COFO	CCD	CMEF
COFO	1		
CCD	.458	1	
CMEF	.315	.450	1

Note. Correlation is significant at the 0,01 level (2-tailed).

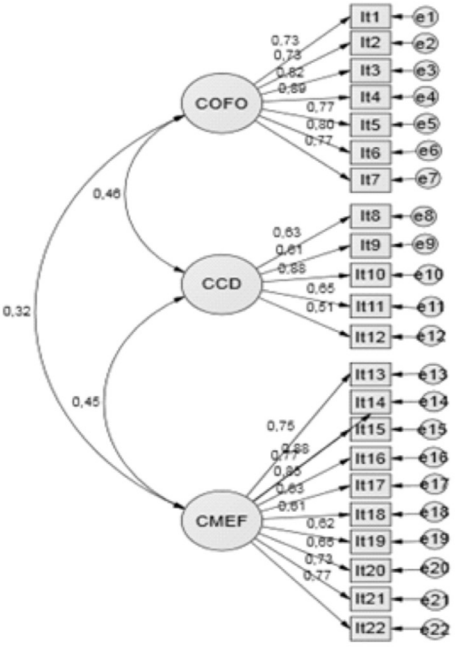

Figure 1. Confirmatory Factor Model of the EFS-VM, modified version.

Discussion

In the first phase of validation of the EFS, its factor model, composed of four dimensions and adjusted to the same sample of 698 observations, had poor goodness-of-fit values (χ^2/df = 23.854; CFI = .890; TLI = .879; RMSEA = .082; P(RMSEA ≤ .05), so the initial model was refined. The new factor model of the modified version had more acceptable results. Overall, the EFS-VM items had a good sensitivity, with the exception of items 17 and 18 (both included in the CMEF dimension), with high asymmetry values. Despite these values, we decided to keep these items in the scale taking into account that they had factor loadings > .40, and a good Cronbach's alpha of internal consistency for the CMEF dimension (α = .818) and for the overall scale (α = .856). Additionally, these values may be associated with the professionals' observation. Based on the Cronbach's alpha, the COFO and CCD dimensions had acceptable reliability and the CMEF dimension had good reliability (Hill & Hill, 2009; Marôco, 2014b). The standardized alpha values were lower, but still acceptable, in the COFO and CCD dimensions (α = .795 and α = .655, respectively), whereas the CMEF dimension had a higher standardized alpha (α = .818). Overall, the scale had a good internal consistency with a standardized alpha higher than .80 (α = .856). CR estimates the internal consistency of the items reflecting the construct, indicating the extent to which items reflect the latent factor. The EFS-VM had indicators of good reliability, that is, values higher than .70 (CR_{COFO} = .953; CR_{CCD} = .861, and CR_{CMEF} = .951). The convergent validity of the three factors was calculated based on the AVE. The obtained results (AVE_{COFO} = .745; AVE_{CCD} = .561, and AVE_{CMEF} = .661) were higher than the reference value (AVE ≥ .50), thus they were considered adequate to this type of studies (Marôco, 2014b).

The three dimensions of the scale are positively correlated (low to mild intensity) and statistically significant (p < .001). However, the square of interfactor correlations is lower than the AVE for each factor, confirming the discriminant validity of the three factors. In other words, despite being correlated, the factors measure the infants' different early feeding skills. The goodness-of-fit of the EFS-VM three-factor model is acceptable. Factor loadings were higher than the reference values (.40) and goodness-of-fit indices supported the three-dimension structure of the EFS-VM: COFO (five items), CCD (seven items), and CMEF (10 items; [$\chi^2(186)$ = 913.206; p < .001; n = 698; χ^2/df = 4.91; CFI = 0.903; TLI = .890; RMSEA = .075, P[rmsea≤.05] < .001; Figure 1). In view of the above, this scale shows an adequate factorial validity, sensitivity, and reliability in the sample of Portuguese preterm infants. The dimension that was removed in the first phase of model validation mainly assessed the infant's quiet awake state and energy for feeding, which is implicitly assessed in the other dimensions. In practical terms, it is not relevant to the assessment of the infant's early feeding skills.

Conclusion

The EFS-VM allows for the general observation of preterm infants, and the specific observation of their early feeding skills, thus facilitating the caregivers' decision-making. This instrument allows health professionals and/or parents to assess the entire feeding process (breast/bottle-feeding), which includes the observation of early feeding skills in three key dimensions: the Ability to organize oral-motor functioning, the Ability to coordinate swallowing, and the Ability to maintain physiological stability. The EFS-VM is supported by vast research, particularly in the United States. With regard to Portuguese preterm infants, the modified version showed adequate sensitivity, reliability, and factorial validity; thus, it can be seen as an instrument that contributes to the infant's observation during feeding. Therefore, apart from its implementation in clinical practice, its application in research should be considered. Based on the adjustment of the factorial model, we propose a modified version of the scale (EFS-VM), with the purpose of observing changes in the infants' skills during oral feeding and, thus, facilitating an adjustment of the care plan and the development of these interventions in collaboration with the families.

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