Original Article

Psychometric evaluation of the Screening Tool for Feeding Problems (STEP) in Saudi children with developmental disabilities aged 4-18 years

Walaa Abdullah Mumena PhD[1], Eradah Omar Hamad PhD[2], Hebah Alawi Kutbi RD, PhD[3]

[1]*Clinical Nutrition Department, College of Applied Medical Sciences, Taibah University, Madinah, Saudi Arabia*
[2]*Department of Psychology, Faculty of Arts and Humanities, King Abdulaziz University, Jeddah, Saudi Arabia*
[3]*Department of Clinical Nutrition, Faculty of Applied Medical Sciences, King Abdulaziz University, Jeddah, Saudi Arabia*

Background and Objectives: Children with developmental disabilities commonly experience feeding problems; however, tools to assess the nature and extent of these difficulties are not available in Arabic. This study aims to validate the Arabic version of the Screening Tool for Feeding Problems (STEP) and evaluate its factorial structure in children with developmental disabilities. **Methods and Study Design:** This cross-sectional study involved 167 children with developmental disabilities, recruited from nine disability centers and schools in Madinah, Saudi Arabia. Data were collected from caregivers using a paper version of the Arabic version of STEP, which was sent home with the child along with a consent form for signature. The English-to-Arabic translation of the tool was conducted by a bilingual professional using the forward-backward translation method. **Results:** Confirmatory factor analysis was performed to evaluate the factorial structure of the Arabic version of STEP using two models. Model 1 included all 23 items; Model 2 excluded six items with low factor loadings, resulting in a 17-item version. Model 2 demonstrated improved goodness of fit indices, supporting a modified five-factor structure. Reliability analysis showed acceptable internal reliability for the total scale in both models, with Cronbach's alpha of 0.80 and McDonald's omega of 0.79 for Model 1, and alpha of 0.83 and omega of 0.82 for Model 2. Internal consistency for individual factors ranged from 0.31 to 0.70. **Conclusions:** The Arabic version of STEP demonstrates satisfactory psychometric properties and appears to be a valid and reliable tool for screening feeding difficulties in children with developmental disabilities in the Saudi Arabian context.

Key Words: developmental disabilities, feeding problems, STEP, psychometric properties, children

INTRODUCTION

Studies on children with developmental disabilities have become a global research priority.[1,2] The term "developmental disability" encompasses individuals with intellectual disabilities, physical disabilities, or a combination of both.[3] A recent report by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) underscores the right of these children to enjoy the highest attainable standards of health and well-being. The report advocates for an approach that focuses on enhancing the environments of children with developmental disabilities in their homes, schools, and communities.[1]

Similarly, the Saudi Government has launched an anti-discrimination policy aimed at protecting and promoting the rights of individuals with disabilities. This policy ensures access to healthcare services, including medical, psychological, social, educational, and rehabilitation services, through public agencies, public-private partnerships, and charitable/nonprofit organizations.[4,5] Several initiatives have also been implemented to improve the management and treatment of conditions affecting individuals with disabilities.[6] However, current literature indicates a lack of research on disabilities in Saudi Arabia.[4] Such data are crucial for the effective planning and management of programs for children living with disabilities.

Children with developmental disabilities are at a particularly high risk of feeding difficulties due to associated medical and/or psychological issues.[7,8] Data have shown that up to 90% of children with developmental disabilities

Corresponding Author: Dr Walaa Abdullah Mumena, Clinical Nutrition Department, College of Applied Medical Sciences, Taibah University, P.O. Box 344, Madinah, 42353, Saudi Arabia
Tel: +966530819399
Email: wmumena@taibahu.edu.sa
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experience some level of feeding disorder, placing them at increased risk of malnutrition.[9] Other factors contributing to malnutrition in this vulnerable population include increased nutrient losses, increased basal metabolic rate, and inadequate dietary intake.[10,11] The diets of children with disabilities are significantly lower in protein and overall calories compared to children without disabilities.[12] However, the risk of malnutrition may differ depending on the type and severity of disability. In children with intellectual disabilities, the severity of the condition was not found to be linked to higher levels of malnourishment.

The prevalence of developmental disabilities combined with malnourishment is high in the Arab world.[13] The Screening Tool of Feeding Problems (STEP) was originally developed by Matson and Kuhn (2001) and has since been translated and used in several studies.[13–17] However, a valid and reliable Arabic version of the STEP remains unavailable. Therefore, this study aims to validate the Arabic version of the Screening Tool for Feeding Problems (STEP-AR) and to evaluate its factorial structure in children with developmental disabilities.

METHODS

Study design and population

Cross-sectional data were collected from caregivers of children with developmental disabilities at nine disability centers and schools in Madinah, Saudi Arabia, between November 2023 and March 2024. All participating caregivers provided their written informed consent. Ethical approval for this study was obtained from the Ethical Committee at the College of Applied Medical Sciences at Taibah University, Madinah, Saudi Arabia (Certificate: 2024/177/203 CLN). The research was conducted in strict accordance with the principles outlined in the Declaration of Helsinki for experiments involving human subjects. All guidelines for ethical research practice were meticulously followed.

Data collection

At the participating schools and centers, a total of 666 children with developmental disabilities were given envelopes to take home to their caregivers. Each envelope contained a description of the study's aim and protocol, demographic information, the STEP, and the consent form. Envelops were distributed to all children at the beginning of the week (Sunday and Monday) and were collected within one week. Phone interviews were conducted with main caregiver to collect data concerning dietary intake (two/three 24-dietary recalls (non-consecutive days, one weekend day and two weekdays). The intake within the last 24 hours was recorded in a word file which was then entered into the nutrition analysis program Nutritics https://www.nutritics.com/en/ (version 5.09, Dublin, Ireland).

The STEP is a 23-item instrument specifically designed for use with children who have various developmental disabilities.[15] This scale has been translated into numerous languages and adapted for different cultural contexts, including Turkish.[17] Various studies have proposed different factorial structure for the STEP, including eight factors,[15] six factors,[16] and five factors.[17] In this study, a five-factor model was used for utilized for data collection, focusing on feeding difficulties categorized into the following factors: 1. *Aspiration Risk* (*item 18 and 20*), 2. *Food Refusal Related Behavior Problems* (*item 2, 13, and 19*), 3. *Selectivity* (*item 6, 10, 20, 22, and 23*), 4. *Nutrition Related Behavior Problems* (*item 7, 9, 11, 12, and 14*), and 5. *Skills* (*item 1, 3, 4, 5, 8, 15, 16, and 17*). For each identified problem, caregivers were first asked to select the frequency: "occurring between 1 and 10 times in the last month" (coded as 1) or "more than 10 times in the last month" (coded as 2). If the item was not applicable, caregivers could proceed to the next item. For problems that did affect the child to some extent, caregivers were instructed to indicate the severity of the problem, choosing from: "causes no problems" (coded as 0), "causes minimal problems/harm" (coded as 1), or "causes serious problems/harm" (coded as 2). If the selected frequency was "0", data collection personnel would simply progress to the following question.

Translation process of STEP

The STEP was translated from English to Arabic by two bilingual professionals in the field of nutrition using the forward-backward translation method.[18] Each translator was a native Arabic speaker and fluent in English. The researchers then developed a reconciled version, which as back-translated into English by another professional translator. The two source language versions were compared to ensure consistency in the interpreted terms. The translated version was pilot-tested with 14 caregivers to assess clarity, relevance, and appropriateness of the wording. Subsequently, a meeting was held among the researchers to ensure that the original scale and the translated versions were harmonized.

Data analysis

Data were analysed using IBM SPSS version 30 and Amos version 24. Descriptive statistics were reported as frequencies and percentages for categorical variables, and means ± standard deviation or medians with interquartile ranges for continuous variables, as appropriate. The internal reliability of the overall STEP-AR and each of its individual factors was assessed using both Cronbach's alpha (α) and McDonald's omega (ω) coefficients. To evaluate the factorial structure of the STEP-AR, two models were tested using confirmatory factor analysis (CFA). Model 1. (correlated variables) included all original items with correlated variables as suggested by Meral & Fidan.[17] Model 2. (eliminated items) excluded items with low factor loadings and poor fit indices in Model 1. Items were eliminated to enhance the overall model fit. Factor loadings and goodness of fit indices were calculated for both models. Factor loadings were considered acceptable if they exceeded ± 0.30. The fit of each model was assessed using several indices:[19] Chi-Square, Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residual (RMR), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). The criteria for a well-fitting model included a Chi-Square value that was expected to be small, RMSEA $\leq$ 0.06-0.08, RMR $\leq$ 0.05, GFI $\geq$ 0.95 (well fit), AGFI $\geq$ 0.90 (good

fit), CFI ≥ 0.95, and TLI ≥ 0.95.[20] These criteria ensure that the model fits the data well and provides reliable and valid results for the assessment of feeding problems in children with developmental disabilities.

RESULTS

Sample characteristics

Data of 167 children with developmental disability were included in this study. The primary caregivers who participated were predominantly mothers (n = 146, 87.4%), aged between 31 and 40 years (n = 77, 46.1%), and possessed a bachelor's or postgraduate degree (n = 77, 46.1%).

Among the children, over one-quarter were diagnosed with autism spectrum disorder (n = 44, 26.3%), and about one-fifth had attention deficit hyperactivity disorder (n = 35, 21.0%). The sample comprised 58% boys (n = 96), with 46.7% (n = 78) of the children aged between 4 and 8 years. Table 1 provides an overview of the sample characteristics.

Dietary data were collected from a sub-sample of children (n= 32). Mean energy intake was 1390 ± 517 kcal/d; mean carbohydrate intake was 178 ± 74.4 g/d; mean protein intake was 56.0 ± 47.4 g/d; mean fat intake was 52.3 ± 23.7 g/d. Detailed descriptive data concerning micronutrient intake are provided in Table 2.

Confirmatory factor analysis (CFA)

The CFA was conducted on the two proposed models (Figure 1 and Figure 2) to evaluate the factorial structure of the STEP-AR. Standardized loadings for the two models are presented in Table 3. The CFA results indicate that Model 2 demonstrated improved goodness of fit indices compared to Model 1 (Table 4), suggesting a better fit for the data after eliminating six items (item 7, 8, 14, 16, 17, and 20). This improvement indicates that Model 2 is more robust and reliable for screening feeding problems in children with developmental disabilities in the Saudi Arabian context.

Reliability analysis

The reliability of the STEP-AR was evaluated using both α and ω coefficients. The overall scale demonstrated good internal consistency, with α= 0.83 and ω= 0.82. For the individual factors, internal consistency values ranged from 0.31 to 0.70 (α) and from 0.48 to 0.72 (ω), indicating varying levels of reliability across subscales. The lowest reliability was observed in a factor comprising only two items (Factor 1), which also prevented the calculation of omega due to software limitations (Table 5).

DISCUSSION

The global prioritization of research on children with developmental disabilities underscores the urgent need for validated tools and strategies to address their complex needs.[1,2] Children with developmental disabilities often experience feeding difficulties due to associated medical and psychological conditions,[7,8] which may lead to malnutrition and other health complications.[9] The increasing prevalence of developmental disabilities in Saudi Arabia highlights the necessity for effective assessment tools tailored to Arabic-speaking populations.[21,22] In response

Table 1. Sample characteristics (n = 167)

Variables	n	%
Main caregiver		
Mother	146	87.4
Father	14	8.40
Others	7	4.19
Caregiver age		
20-30 years	35	21.0
31-40 years	77	46.1
> 40 years	55	32.9
Caregiver education level		
< High school	45	26.9
High school/diploma	45	26.9
Bachelor's degree	70	41.9
Postgraduate degree	7	4.20
Type of disability		
Attention deficit hyperactivity disorder	35	21.0
Autistic spectrum disorder	44	26.3
Cerebral palsy	22	13.2
Intellectual disability	21	12.6
Learning disability	25	15.0
Growth delay	7	4.20
Down syndrome	10	6.00
Other developmental disabilities	3	1.80
Child sex		
Boys	96	57.5
Girls	71	42.5
Child age		
1-3 years	11	6.60
4-8 years	78	46.7
9-13 years	58	34.7
14-18 years	20	12.0

Table 2. Dietary intake data of children with developmental disability (n= 32)

Dietary intake	Mean ± SD	Median (IQR)
Energy, kcal/d	1390 ± 517	1297 (1010- 1693)
Carbohydrate, g/d	178 ±74.4	157 (120-216)
Protein, g/d	56.0 ± 47.4	47.3 (33.0-66.3)
Fat, g/d	52.3 ± 23.7	47.3 (35.5- 73.3)
Fiber, g/d	14.8 ± 14.3	11.8 (6.97- 17.6)
Free sugar, g/d	33.1 ± 63.4	20.6 (10.3-32.4)
Sodium, mg/d	3192 ± 4118	2201 (965- 2954)
Potassium, mg/d	1420 ± 896	1216 (833-1745)
Calcium, mg/d	549 ± 294	525 (358- 719)
Phosphors, mg/d	614 ± 306	613 (402- 774)
Magnesium, mg/d	129 ± 64.2	123 (80.4- 188)
Iron, mg/d	9.14 ± 4.73	7.98 (5.27- 12.5)
Zinc, mg/d	4.52 ± 2.46	4.31 (2.55- 5.78)
Vitamin D, mg/d	15.1 ± 39.0	2.84 (0.61- 5.47)
Vitamin B-12 mg/d	2.31 ± 4.61	1.45 (0.58- 2.41)
Vitamin C, mg/d	50.9 ± 37.7	39.4 (21.4- 89.8)

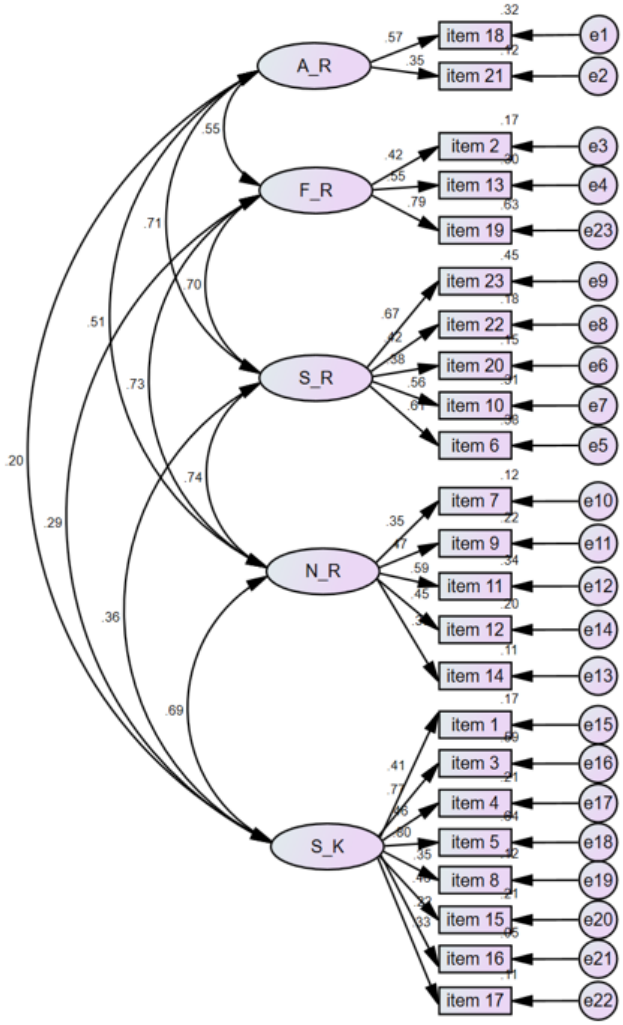

Figure 1. Standardized loadings of Model 1

to this need, the Saudi Government has implemented policies to protect and promote the rights of individuals with disabilities, ensuring their access to comprehensive healthcare services.[4,6] However, there remains a gap in research specifically focusing on the assessment of feeding problems within this population in Saudi Arabia. The present study addresses this gap by translating STEP into Arabic and evaluating its validity and reliability in a sample of children with developmental disabilities in Madinah, Saudi Arabia.

This study represents the first attempt to validate an Arabic version of STEP among children with developmental disabilities in the Saudi Arabian context. The findings support the STEP-AR as a psychometrically sound instrument for identifying a wide range of feeding problems. Confirmatory factor analysis supported a modified

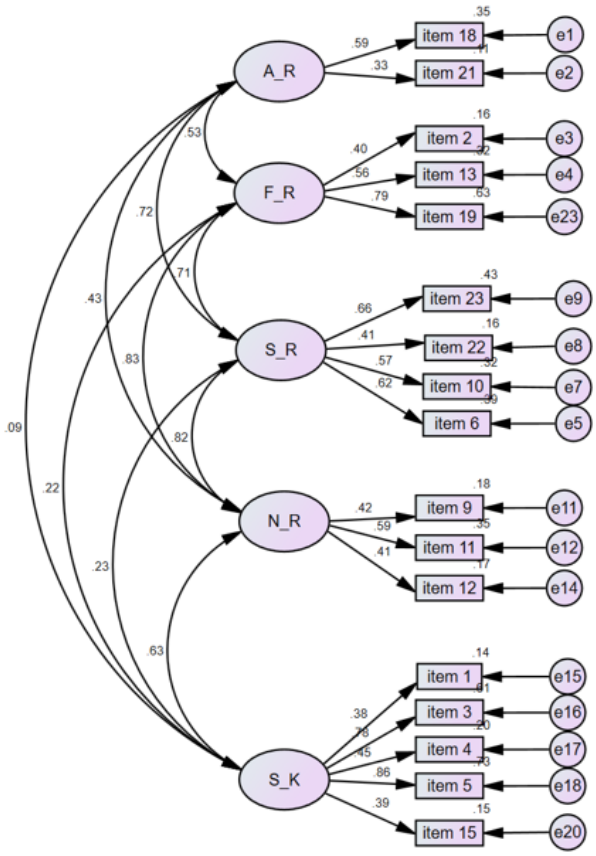

Figure 2. Standardized loadings of Model 2

five-factor structure (Model 2), which excluded six items with low factor loadings and showed improved model fit. This structure aligns with the Turkish version of the tool and diverges from the original eight-factor model, reflecting cultural influences on scale dimensionality.

An interesting aspect of the STEP's cross-cultural adaptations is the variation in its factorial structure across different cultural contexts. While the original version of the proposed an eight-factor model,[15] adaptations in other settings have identified alternative structures, such as a five-factor model in the Turkish version,[17] and a six-factor model in other studies.[16] The current five-factor solution of the STEP-AR, refined through model adjustments to improve fit indices, reflects this variability and highlights the scale's adaptability. These structural differences are likely influenced by cultural factors, such as dietary habits, family dynamics, and social norms, which can influence the relevance of specific items. In Arab cultures, for instance, traditional meal patterns, collective food practices, and the central role of family in food-related decisions may shape how individuals interpret and respond to certain items. Additionally, cultural expectations around meal timing, food sharing, and parental authority may affect item relevance and factor loading. In the current study, items related to food stealing, eating at specific temperatures, or requiring a specific feeding position were excluded due to weak statistical performance, possibly due to caregiver misunderstanding, limited awareness, or sociocultural norms that shape feeding perceptions. Acknowledging these influences underscores the importance of cultural adaptation in psychometric validation and invites future research to explore these dimensions more deeply, enhancing the scale's cross-cultural robustness.

The STEP-AR demonstrated strong internal consistency at the scale level ($\alpha = 0.80$; $\omega = 0.79$ in Model 1; $\alpha = 0.83$; $\omega = 0.82$ in Model 2). Subscale reliability varied, with the lowest α observed in the "aspiration risk" factor ($\alpha = 0.31$), which contained only two items. Due to this, omega could not be calculated for that subscale. Similar issues were observed in the Turkish adaptation,[17] suggesting that structural limitations, rather than translation accuracy alone, contributed to the low reliability. Item-level analysis revealed that one item had particularly weak correlations, supporting its re-evaluation or potential rewording. Enhancing internal consistency may be achievable by refining item content, expanding the number of items, and conducting qualitative assessments to ensure both cultural and conceptual clarity.

Several excluded items may still hold contextual or clinical relevance. For example, items such as "requires a specific position when eating" or "swallows food without chewing" may reflect caregiver knowledge gaps rather than item irrelevance. Similarly, item 8, which also performed poorly in the Turkish version,[17] may have been affected by caregivers' limited familiarity with adaptive feeding tools. These findings emphasize the need for mixed-methods validation approaches that include both quantitative psychometrics and qualitative caregiver insights.

The availability of STEP-AR enables targeted interventions to be designed and implemented, which can significantly reduce malnutrition and improve the nutritional health of children with developmental disabilities. STEP-

Table 3. Standardized loadings for translated items

#	Item (English and Arabic)	Model 1†	Model 2‡
	Factors 1. Aspiration risk		
18	He/she regurgitates and re-swallows food either during or immediately following. ترتجع/يرتجع ويبتلع الطعام مرة أخرى أثناء الوجبات أو بعدها مباشرة.	0.56	0.59
21	He/she vomits either during or immediately following meals. تتقيأ/يتقيأ أثناء الطعام أو بعده مباشرة.	0.34	0.33
	Factor 2. Food refusal related behavior problems		
2	Problem behaviors (e.g., aggression, SIB) increase during meal times. تزيد المشكلات السلوكية (مثل العدوان، الضرب الذاتي) أثناء وجبات الطعام.	0.41	0.40
13	He/she spits out their food before swallowing. تبصق/يبصق الطعام قبل بلعه.	0.55	0.56
19	He/she pushes food away or attempts to leave the area when food is presented. تدفع/يدفع الطعام جانبا أو يحاول المغادرة عند تقديم الطعام.	0.79	0.79
	Factor 3. Selectivity		
6	He/she will only eat selected types of food (e.g., pudding, rice). تتناول/ يتناول أنواعا محددة من الطعام فقط (مثل المهلبية، الأرز).	0.61	0.62
10	He/she prefers a certain setting for eating (e.g., bedroom, dining room). تفضل/يفضل مكانًا معينًا لتناول الطعام (مثلا غرفة النوم، غرفة الطعام).	0.55	0.56
20	He/she will only eat foods of a certain temperature. تتناول/ يتناول الطعام عند درجة حرارة معينة.	0.38	eliminated
22	He/she prefers to be fed by a specific caregiver, or prefers to be fed rather than feed him/herself. تفضل/يفضل أن يتم تغذيته من قبل شخص محدد أو يفضل أن يتم إطعامه بدلاً من تناول الطعام بنفسه.	0.42	0.40
23	He/she eats foods only of certain textures. تأكل/يأكل أطعمة ذات قوام معين فقط.	0.67	0.65
	Factor 4. Nutrition related behavior problems		
7	He/she steals or attempts to steal food from others during meals. أثناء الوجبات تسرق/يسرق أو يحاول سرقة طعام الآخرين .	0.34	eliminated
9	He/she eats or attempts to eat items that are not food. تأكل/ يأكل أو يحاول تناول مواد غير غذائية.	0.47	0.42
11	He/she only eats a small amount of the food presented to him or her. تتناول/ يتناول كمية قليلة فقط من الطعام الذي يتم تقديمه له.	0.58	0.59
12	He/she will continue to eat as long as food is available. تستمر/ يستمر في تناول الطعام مادام متاحا.	0.44	0.41
14	He/she steals or attempts to steal food outside of mealtime. تسرق/يسرق أو يحاول سرقة الطعام خارج أوقات الوجبات.	0.33	eliminated
	Factor 5. Skills		
1	He/she cannot feed him/herself independently. لا تستطيع/يستطيع الاعتماد على نفسه في تناول الطعام.	0.41	0.38
3	He/she does not demonstrate the ability to chew. لا تظهر/يُظهر القدرة على المضغ.	0.77	0.78
4	He/she chokes on food. تختنق/يختنق عند تناول الطعام.	0.46	0.45
5	He/she does not demonstrate the ability to swallow. لا تظهر/يُظهر القدرة على البلع.	0.79	0.85
8	He/she requires special equipment for feeding (e.g., G-tubes, scoop dishes). تحتاج/يحتاج إلى أدوات خاصة للطعام (مثل أنابيب المعدة التغذوية، الأطباق المانعة لانسكاب الأطعمة).	0.34	eliminated
15	He/she eats a large amount of food in a short period of time. تتناول/يتناول كمية كبيرة من الطعام في فترة قصيرة.	0.45	0.38
16	He/she requires special positioning during meals. تحتاج/يحتاج إلى وضعية معينة للجسم أثناء الوجبات.	0.21	eliminated
17	He/she swallows without chewing sufficiently. تبتلع/ يبتلع الطعام دون مضغه بشكل كافٍ.	0.32	eliminated

†Model 1: original tool.
‡Model 2: modified tool.

AR provides clinicians with a structured framework to identify specific feeding challenges, such as aspiration, food refusal, selective eating, or oral-motor difficulties, which can inform the design of targeted, child-centered interventions. For instance, children at risk of aspiration may benefit from caregiver training in texture modification and safe swallowing techniques. Those demonstrating food refusal could be supported through behavioral strategies, including gradual exposure to new foods and positive reinforcement. Selective eaters may respond well to sensory-based approaches and structured meal planning routines. Additionally, children with oral-motor difficulties might benefit from occupational or feeding therapy to enhance self-feeding and chewing skills. By tailoring interventions to the child's specific profile, informed by STEP-AR subscale scores, professionals can offer more effective and contextually relevant support. Integrating STEP-AR into routine clinical assessments can facilitate early detection and management of feeding problems, ultimately contributing to improved nutritional

Table 4. Fit indices of the STEP-AR (n = 167)[†]

Criteria	$\chi 2$ (df)	RMSEA	RMR	GFI	AGFI	CFI	TLI
Model 1	592.942 (220)	0.09	0.02	0.79	0.737	0.64	0.58
Model 2	237.535 (109)	0.08	0.02	0.86	0.81	0.78	0.73

[†]Reliability analysis. Model 1: original tool. Model 2: modified tool.

Table 5. STEP-AR reliability statistics

Factor	No. of Items	Original (Model 1)		Current (Model 2)	
		Cronbach's α	Omega	Cronbach's α	Omega
Factor 1. Aspiration risk	2	0.31	Not computed	0.31	Not computed
Factor 2. Food refusal relation behavior problems	3	0.59	0.64	0.59	0.64
Factor 3. Selectivity	5 → 4 (after removal)	0.66	0.66	0.64	0.64
Factor 4. Nutrition relation behavior problems	5 → 3 (after removal)	0.56	0.53	0.46	0.48
Factor 5. Skills	8 → 5 (after removal)	0.70	0.69	0.69	0.72
STEP-AR (Total)	23 → 17 (after removal)	0.80	0.79	0.83	0.82

outcomes and quality of life. Collaboration among multidisciplinary healthcare teams, including pediatricians, dietitians, speech-language pathologists, and occupational therapists, is essential to ensure comprehensive, child-centered care. Previous research supports the efficacy of such tailored interventions in enhancing dietary intake and nutritional status in this population.[23]

Despite the promising findings, some limitations should be stated. The relatively low response rate, along with the recruitment of participants from a single city in the Western region of Saudi Arabia, may constrain the generalizability of the findings. Additionally, dietary data were collected from a subsample, which may limit the generalizability of the findings. Future research should aim to address these limitations by recruiting a larger and more diverse sample by collecting dietary data from the entire cohort to strengthen the validation of STEP-AR. Although six items were excluded from the final model, further investigation of their potential relevance is warranted, particularly within specific subpopulations. Revising the item wording and testing their performance in broader, more diverse samples may enhance the tool's psychometric robustness. Qualitative methods, such as interviews or focus groups with caregivers, could provide deeper insight into how feeding behaviors are understood and reported across cultural contexts.

Conclusion

STEP-AR has proven to be an effective screening tool for identifying feeding problems in children with developmental disabilities in Saudi Arabia. Implementing routine assessments using the STEP-AR can enable healthcare professionals to design and implement targeted interventions, addressing specific issues and ultimately enhancing the nutritional health and well-being of these children. This tool fills a critical gap in the resources available to healthcare providers in Arabic-speaking populations and supports the broader goals of improving health outcomes for children with developmental disabilities. Future longitudinal research is recommended to evaluate the predictive validity of the tool over time.

CONFLICT OF INTEREST AND FUNDING DISCLOSURES

The authors declare no conflict of interest.

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