



COMPREHENSIVE REVIEW OF ASSESSMENT TOOLS FOR NUTRITION AND FEEDING PRACTICES IN EARLY CHILDHOOD: APPLICATIONS, STRENGTHS, AND LIMITATIONS

Ruzha Pancheva^{1,2*}, Maria Dzhogova¹, Sevdzhihan Eubova^{2,3}, Petya Hristanova^{2,4}, Stanislava Pavlova^{2,4}, Lyubomir Dimitrov¹, Niya Rasheva⁵, and Krassimira Koleva⁵

¹Department of Hygiene and Epidemiology, Faculty of Public Health, Prof. Paraskev Stoyanov Medical University Varna, Bulgaria, ²Research Group NutriLect, Department of Neuroscience, Research Institute, Medical University, Varna, Bulgaria, ³Department of Preschool and Primary School Education, Faculty of Education, Konstantin Preslavsky University, Shumen, Bulgaria, ⁴Department of Speech Therapy and Medical Pedagogy, Faculty of Public Health, Medical University, Varna, Bulgaria, ⁵Department of Paediatrics, Faculty of Medicine, Medical University, Varna, Bulgaria

*This narrative review provides a significant contribution to the field of developmental disabilities by providing a comprehensive and up-to-date analysis of the prevalence and patterns of malnutrition in individuals with cerebral palsy. The findings from this study shed light on the high prevalence of malnutrition and associated factors, such as motor impairment severity, functional limitations, feeding difficulties, and socio-demographic factors. By synthesizing the existing literature from global studies, this manuscript enhances our understanding of the complex relationship between malnutrition and cerebral palsy, providing valuable insights for clinicians, researchers, and policymakers. The comprehensive nature of this review, encompassing various continents and countries, helps to identify regional variations in malnutrition prevalence and highlights the need for targeted interventions and tailored nutritional care strategies for individuals with cerebral palsy worldwide. **Biomed Rev 2023; 34: 41-59***

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*Correspondence to: Dr Ruzha Pancheva, Department of Hygiene and Epidemiology, Faculty of Public Health, Prof. Paraskev Stoyanov Medical University, 55 Marin Drinov Str., BG-9002 Varna, Bulgaria
Tel.: +359 897 717 966 Email: ruzha.pancheva@gmail.com

LIST OF ABBREVIATIONS

AIM-2: Automatic Ingestion Monitor
 BEBQ: Baby Eating Behavior Questionnaire
 CFSQ: Caregiver's Feeding Style Questionnaire
 EAT FFQ: Eating Assessment in Toddlers FFQ
 EFS: Early Feeding Skills scale
 FRA: Feeding Readiness Assessment
 IBFAT: Infant Breastfeeding Assessment Tool
 ICFI: Infant and Child Feeding Index
 IFQ: Infant Feeding Questionnaire
 INSIGHT: Intervention Nurses Start Infants Growing on Healthy Trajectories Study
 NeoEAT: Neonatal Eating Assessment Tool
 NeoEAT-Bottle-feeding: Neonatal Eating Assessment Tool-Bottle-feeding
 NeoEAT-Mixed Feeding: Neonatal Eating Assessment Tool-Mixed Breastfeeding and Bottle-Feeding
 NOMAS: Neonatal Oral-Motor Assessment Scale
 OFEATING: Oral Feeding Assessment in premature infants instrument
 TFQ: Toddler Feeding Questionnaire

INTRODUCTION

Nutrition assessment in early childhood is a critical endeavor with far-reaching implications for child health and development (1). The dynamic nature of early growth and the profound impact of nutrition during this period (2) necessitate precise and comprehensive assessment tools. Recent advancements in research have led to the development and refinement of various instruments tailored to evaluate the multifaceted dimensions of nutrition in infants and young children. In this article, we embark on a systematic exploration of these nutrition assessment instruments, drawing insights from a compendium of recent research studies.

Our objective is twofold. Firstly, we provide a comprehensive overview of these instruments, elucidating their intended target groups, specific purposes, and the key parameters they measure. These instruments, finely tuned to cater to various age groups and nutritional domains, serve as indispensable resources in the pursuit of early childhood nutrition elucidation. Secondly, we undertake a critical examination of the strengths and limitations inherent to each instrument. Through rigorous analysis and synthesis of recent research findings, we seek to unravel the practical contexts in which these instruments have been employed. Thus, we aim to contribute to the enhancement of early childhood nutrition assessment methodologies, shed-

ding light on areas that warrant further investigation.

Our endeavor is driven by the imperative to elucidate the value these instruments bring to the realm of early childhood nutrition research and practice. While we highlight their strengths, we do not shy away from exposing their limitations, offering valuable insights for researchers, healthcare professionals, and policymakers alike.

The synthesis of recent research findings and the critical evaluation of these assessment instruments represent an essential step towards a more nuanced and comprehensive understanding of early childhood nutrition. This article serves as a valuable resource for researchers and practitioners seeking to navigate the intricate landscape of nutrition assessment in the crucial early years of life.

METHODOLOGY

The present narrative review adheres to the general framework outlined by Ferrari R *et al* and conforms to the standards set by the SANRA (3). It also includes some additional elements that follow the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (4).

Search strategy and research sources

In February 2023, a search strategy was executed across four bibliographic databases: Scopus, Medline, PubMed, and Web of Science. The search aimed to identify relevant references on nutritional assessment instruments in early childhood published between 2018 and February 2023.

Although there were initially no language restrictions, for consistency and linguistic accuracy, only English language articles were included in the final review.

A combination of the following terms and keywords was used in the search strategy: Feeding assessment OR eating assessment OR Assessment of feeding behavior OR Assessment of eating behavior AND Feeding questionnaires OR eating questionnaires OR Feeding measures OR eating measures AND Early childhood period (0 to 3y) AND Feeding difficulties AND Feeding disorders AND Infants OR Toddlers. Search sensitivity was improved by incorporating synonyms, and references from key papers increased our search range.

The identified abstracts were uploaded to Rayyan, a software for systematic review management (<https://www.rayyan.ai/>), which helped expedite the initial sorting process. By using Rayyan's AI duplicate detection feature, researchers could identify and select unique articles.

Eligibility Criteria

For inclusion in this review, the following criteria were met: 1) studies reporting original observations, 2) studies involving infants, and 3) studies assessing nutritional instruments with information about other tools use, inc. anthropometric measurements, well established nutritional instruments.

The exclusion criteria were as follows: 1) studies reporting a single case, case series, or non-observational studies (e.g., systematic reviews, narrative reviews, scoping reviews), 2) studies involving interventions in the nutrition of specific patient groups, 3) non-English articles, 4) Nutrition assessment

instruments mainly aimed at evaluation of dysphagia or specific swallowing phase and 4) studies involving adults. Conflicting titles (... in total) were selected based on the number of votes or resolved through discussion among the reviewers.

STUDY SELECTION AND DATA EXTRACTION

Our research selection procedure followed the PRISMA model and included identification, screening, eligibility, and final inclusion stages, as shown graphically in a PRISMA flowchart (Fig. 1). There were **2756** titles found with the keyword. We selected **65** studies from an initial examination of the titles

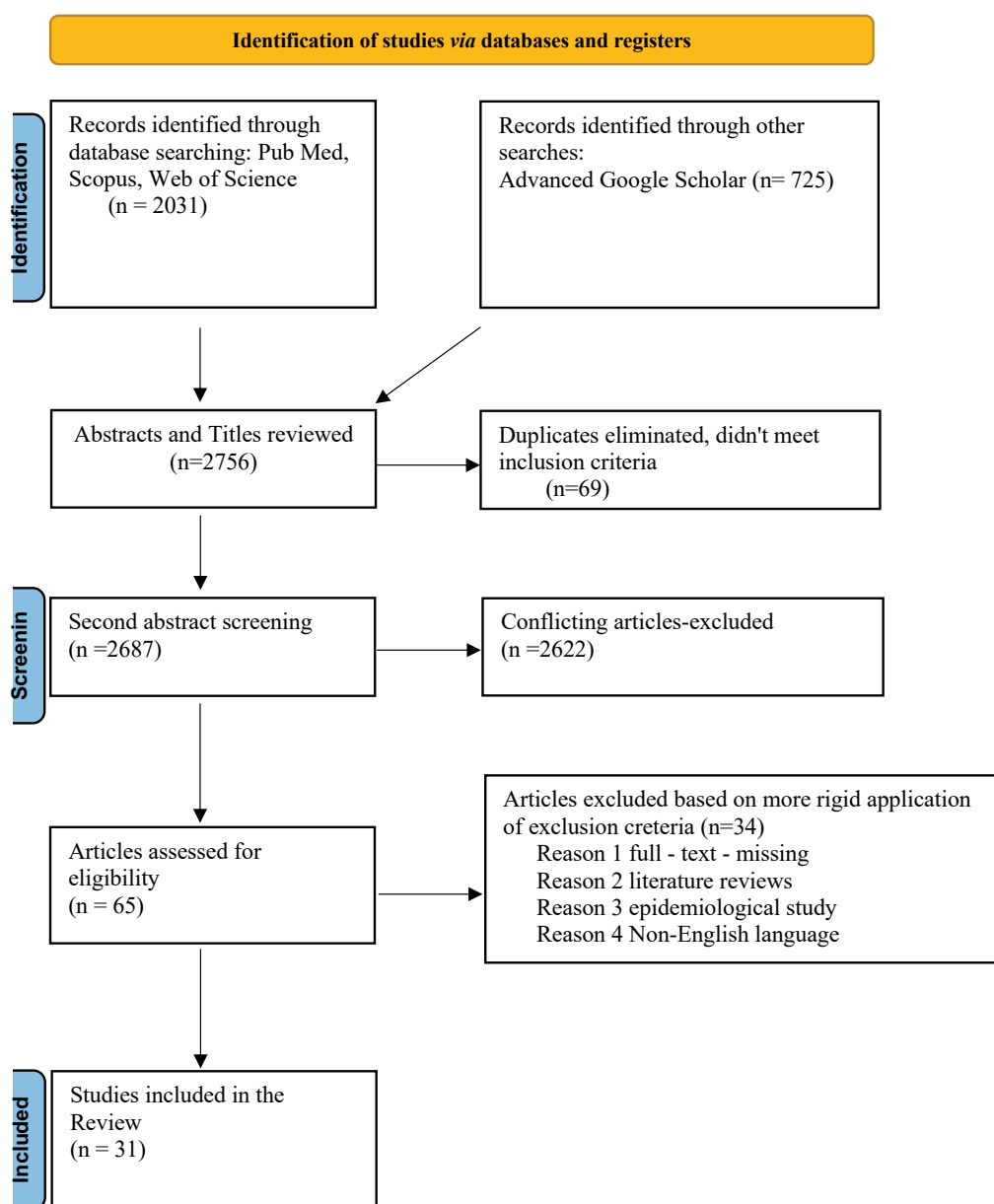


Figure 1. Flowchart of selection process.

and abstracts. Following a full-text examination, this pool was further limited to 31 papers that fully met our inclusion criteria.

A group of four impartial reviewers carried out the data extraction procedure methodically. Each reviewer carefully examined the dataset to identify the publications that satisfied the requirements for inclusion. To maintain an unbiased selection process, disagreements and conflicts were collectively disclosed and resolved by consensus.

The following information was meticulously extracted: 1/ First Author and Year of Publication; 2/ Tool Name; 3/ Age Range of Participants; 4/ Number of Participants; 5/ Setting; 6/ Application of other tools or measurements; 7/ Key parameters measured; 8/ Advantages and Limitations.

Divergences in data extraction were addressed through consensus-based discussions among the reviewers. This

multi-reviewer strategy improved the integrity of our selection process and enhanced the overall quality of our review when utilized with Rayyan for review management. The results of detailed approach helped to enhance this field of study and offer insightful information about the various instruments available for nutritional assessment in young children.

RESULTS

In Table 1, we present a comprehensive overview of various assessment tools designed to evaluate infant and child feeding practices. These tools cater to diverse age groups, from preterm newborns to toddlers, and serve distinct purposes, such as assessing feeding readiness and exploring maternal feeding behaviors (Table 1).

Table 1. Assessment Tools for Early Childhood Nutrition and Feeding Practices

Authors/Refs	Tool Name	Age Range	Number of Participants	Setting	Other Tools Used
Abarzúa P et al (5)	Early Feeding Skills (EFS) scale	Preterm newborns - 34 to 36 weeks	138	Hospital	Oral Feeding Readiness in Preterm Infants - EFS scale can be complemented with observation of non-nutritive sucking skills, mother-child attachment, and breast anatomy.
Alonso-Fernández et al (6)	Oral Feeding Assessment in premature infants (OFEATING) instrument	Premature infants age of 31–35 weeks	56	Neonatal Intensive Care Unit (NICU)	Not specified
Cerminaro et al (7)	Automatic Ingestion Monitor (AIM-2) for infant feeding assessment	Infants ≤ 7 months	38 mothers	Participants' home	Not specified
Corsini et al (8)	Child Feeding Questionnaire Restriction subscale	22–36 months	64 parents and toddlers	Not specified	Toddler Snack Food Feeding Questionnaire (TSFFQ), short snack food frequency questionnaire
Desalegn et al (9)	Feeding Practices questionnaire	6–23 months	575	Not specified	Calibrated portable digital scale, household food insecurity access scale (HFIAS) standard questionnaire
Ehrmann et al (10)	Systematic feeding readiness assessment (FRA)	Neonates and infants ≤ 3 months	69	Hospital	Not specified
Fries et al (11)	Caregiver's Feeding Style Questionnaire (CFSQ)	12–36 months	75 Parents	Participants' homes	Observational coding
Fucile and Dow (12)	The nipple monitoring tool	Born at less than or equal to 34 weeks gestational age	16	NICU	Not specified

Authors/Refs	Tool Name	Age Range	Number of Participants	Setting	Other Tools Used
Guivarch et al (13)	Three-Factor Eating Questionnaire (TFEQ-R21)	2 years	1322	NOT SPECIFIED	Comprehensive Feeding Practices Questionnaire (CFPQ)
Heerman et al (14)	Toddler Feeding Questionnaire (TFQ)	Median child age 4.3 (IQR 3.5-5.0)	529	NOT SPECIFIED	No
Hill et al (15)	Neonatal Eating Assessment Tool-Bottle-feeding (NeoEAT-Bottle-feeding)	0-7 months	625	NOT SPECIFIED	No
Hill et al (16)	Neonatal Eating Assessment Tool (NeoEAT) version (Breastfeeding, Bottle-Feeding, or Mixed Feeding)	0-7 months	25	Dental office in northeast region of United States	Kotlow's criteria and Hazelbaker Assessment Tool for Lingual Frenulum Function (ATLFF)
Hines et al (17)	Breastfeeding Self-Efficacy Scale-Short Form and Neonatal Eating Assessment Tool-Breastfeeding and Bottle-feeding scales	3.06 months (SD = .29), range 2.56-3.76	56	Patients' homes	Non-Nutritive Suck and Oral Feeding Skills Scale
Hyczko et al (18)	Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) Study	28 weeks - 3 years	279	Home visits, clinical research center visits and telephone calls	Infant Feeding Styles Questionnaire (IFSQ), Structure and Control in Parent Feeding (SCPF) Questionnaire and Child Feeding Questionnaire (CFQ)
Iqbal et al (19)	Infant Breastfeeding Assessment Tool (IBFAT)	NOT SPECIFIED	120	NOT SPECIFIED	No
Jansen et al (20)	Feeding Practices and Structure Questionnaire (FPSQ)	0-24 months	530	Online questionnaires	Infant Feeding Questionnaire (IFQ), Infant Feeding Style Questionnaire (IFSQ) and Lakshman et al's questionnaire on maternal attitudes towards infant growth and milk feeding practices (LMFQ)
Kamran et al (21)	Preterm Infant Oral Feeding Readiness Assessment Scale (PIOFRAS)	Preterm infants (\leq 34 weeks)	37 preterm infants	Neonatal intensive care unit (NICU) in Iran.	Early Feeding Skill (EFS) scale
Kim et al (22)	Behavioral Pediatrics Feeding Assessment Scale (BPFAS)	Toddlers with food refusal	16 toddlers in the intervention group - 12 toddlers in the control group	Feeding disorder clinic	Bayley Scales of Infant Development-II (BSID-II) - Behavioral Pediatrics Feeding Assessment Scale (BPFAS), Infant/Toddler Sensory Profile
Kwon et al (23)	Neonatal Eating Outcome Assessment - Pediatric Eating Assessment Tool (PediEAT)	Infants assessed at term-equivalent age and within 4 days of life - Feeding performance evaluated at 4 years of age	91 infants participated in the study.	NICU setting - Parents and healthcare professionals fed the infants.	Behavioral Pediatrics Feeding Assessment Scale (BPFAS) - Neonatal Oral Motor Assessment Scale (NOMAS)

Authors/Refs	Tool Name	Age Range	Number of Participants	Setting	Other Tools Used
(Lei et al., 2022) (24)	Infant and Child Feeding Index (ICFI)	7-24 months, children after heart surgery	Sample size for reliability test: 95 participants - Sample size for validity test: 98 participants	Hospital-China	NOT SPECIFIED
(Lovell et al., 2021)(25)	Eating Assessment in Toddlers FFQ (EAT FFQ) - GUMLi EAT FFQ	Children under 2 years of age - Latter half of the second year of life	Number of participants: 97	Study conducted in two study centers: Auckland and Brisbane - Participants included in the analysis: n=97	Record-assisted 24-h recalls (24HR)
(Martens et al., 2023)(26)	Infant-Toddler Home Observation for Measurement of Environment Inventory (IT-HOME)	3 months and 12 months old.	72 infants completed the study at 3 months of age. - 55 infants completed the study at 12 months of age.	The study was conducted in the infant's home. - The larger study from which the data was collected also took place in the infant's home.	Infant-Toddler Home Observation for Measurement of Environment Inventory (IT-HOME) - Neonatal Eating Assessment Tool (Neo-EAT) - Pediatric Eating Assessment Tool (Pedi-EAT)
(Pados et al., 2019)(27)	Neonatal Eating Assessment Tool (NeoEAT) - NeoEAT -Mixed Breastfeeding and Bottle-Feeding (NeoEAT -Mixed Feeding)	0 to 7 months old.	478 healthy, typically developing infants participated.	Pediatric primary care, high-risk follow-up clinics, feeding special care - Research	NOT SPECIFIED
(Park et al., 2018)(28)	PediEAT (Pediatric Eating Assessment Tool)	Children ranged in age from 6 months to 7 years. - Two-thirds of the children were younger than 3 years.	58 participants.	North Carolina Children's Hospital in Chapel Hill, NC - Parents or caregivers of children receiving treatment from the UNC Pediatric Feeding Team.	NOT SPECIFIED
(Raatz et al., 2019)(29)	System Architecture for Synchronous Paediatric Feeding Assessments	NOT SPECIFIED	Ten typically developing children - Their mothers (n=8)	Paediatric feeding assessments conducted in patient homes - Telepractice system designed for home-based assessments	Desktop computer with Logitech 1080p HD Pro webcam and Jabra SPEAK 410 MS speaker - Personal devices (variety of devices used by participants)
(Raatz et al., 2021)(30)	Telepractice for Bottle-Feeding Assessments	Children aged 1 month to 2 years	Initially consented 33 infants - Data available for analysis from 30 participants	Telepractice appointments conducted in a clinical room. - In-person appointments conducted at the family's home.	Purpose-designed assessment form - Perceptions of Telepractice Feeding Services Questionnaire

Authors/Refs	Tool Name	Age Range	Number of Participants	Setting	Other Tools Used
(Ruggiero et al., 2020)(31)	Babies Need Soothing Questionnaire, Infant Feeding Styles Questionnaire, Structure and Control in Parent Feeding Questionnaire	The study assessed feeding practices at age 1 year. - No specific age range was mentioned in the text.	117 participants (57 in RP group, 60 in control group)	Randomized clinical trial setting - Intervention delivered to first-time mother-infant dyads.	Babies Need Soothing Questionnaire, Infant Feeding Styles Questionnaire, Structure and Control in Parent Feeding Questionnaire
Russell et al (32)	Baby Eating Behavior Questionnaire (BEBQ)	Infants from birth until 9 months of age	Participants not randomly assigned, number not provided.	Mobile health (mHealth) intervention - Participants recruited through various methods, including the web, face-to-face, practitioners, and word of mouth.	Baby Eating Behaviour Questionnaire (BEBQ) - Infant Feeding Questionnaire (IFQ)
Thoyre et al (33)	NOMAS (Neonatal Oral-Motor Assessment Scale) - EFS (Early Feeding Skills)	Upper age limit not determined beyond 50 weeks' PMA. - Longitudinal study needed for varied GAs, PMAs, and comorbidities.	Infants in neonatal, newborn, and pediatric hospital units. - Clinicians: 8 EFStrained clinicians (2 registered nurses, 3 occupational therapists, and 3 speech language pathologists).	Clinical setting for feeding skill assessment.	NOMAS primarily used for categorizing oral-motor function. - EFS used to assess early feeding skills.
Thoyre et al (34)	Pediatric Eating Assessment Tool (PediEAT).	from 6 months to 7 years of age.	567 parents of children aged 6 months to 7 years participated.	Research and clinical practice setting - The Pediatric Eating Assessment Tool can be used in various settings, including research and clinical practice.	NOT SPECIFIED
(Zakria et al (35)	Infant and Young Child Feeding Questionnaire (IYCF-CCPQ)	Age range of child care providers not specified.	200 participants.	Child care centers in northeastern part of Peninsular Malaysia.	NOT SPECIFIED

NUMBER OF PARTICIPANTS

The number of participants across these studies varies significantly. Some studies have relatively small sample sizes, with as few as 16 participants (22). In contrast, larger studies include up to 1322 participants (13). Many studies fall in between, with sample sizes ranging from around 50 to 500 participants.

Overall Age Range

The overall age range covered by these studies is quite extensive, ranging from premature newborns to toddlers and

even older children. Some studies focus specifically on premature infants, while others are designed for toddlers or infants without neurological complications.

Several tools, like the „Early Feeding Skills (EFS) scale“ (5) and „Oral Feeding Assessment in premature infants (OFEATING) instrument“ (6), target premature infants without neurological damage or craniofacial malformations, highlighting their narrow age focus.

On the other hand, tools such as the „Baby Eating Behav-

ior Questionnaire (BEBQ)“ (36) and „Feeding Practices and Structure Questionnaire (FPSQ)“ (20) have a broader scope, covering infants, toddlers, and children up to 7 years.

It’s important to note that while these tools have specific age ranges and target populations, their utility may extend to related age groups or populations, depending on the research objectives and context. Researchers should consider these fac-

tors when selecting the most appropriate tool for their studies.

In this review article, Table 2 provides a comprehensive overview of the selected studies, categorizing them based on the target population and the assessment tools employed. This table serves to encapsulate the breadth and versatility of assessment instruments utilized in the evaluation of nutrition and feeding practices during early childhood.

Table 2. Summary of Studies Using Early Childhood Nutrition and Feeding Assessment Tools

Author, Year	Tool Name	Target Group	Purpose/Objective	Key Parameters Measured	Advantages/Strengths	Limitations
(Abarzúa P et al., 2019) (5)	Early Feeding Skills (EFS) scale	Premature newborns without neurological damage or craniofacial malformations	Evaluate the feeding process in premature newborns comparing with relevant variables	Breastfeeding achievement, feeding skills during the feeding process (the ability to stay focused on feeding, oral motor organization, swallowing, physiological stability, and tolerance to food)	Provides relevant information to describe the oral feeding process in premature infants, allowing identification of areas of difficulty requiring professional treatment	not enough by itself to carry a comprehensive evaluation of the newborn feeding process.
(Alonso-Fernández et al., 2022) (6)	Oral Feeding Assessment in premature infants (OFEATING) instrument	Preterm infants without abdominal pathology, major surgery, or severe neurological disorder	Validate the OFEATING instrument to identify oral feeding skills in premature infants admitted to a Neonatal Intensive Care Unit (NICU)	Capacity to coordinate sucking-swallowing-breathing, capacity to administer oxygen reserves, capacity to take the teat or nipple	Valid and reliable instrument for evaluating the readiness for oral feeding of preterm infants. The inter-rater reliability between professionals and parents is unknown. It lacks evaluation against a gold standard.	The inter-rater reliability between professionals and parents is unknown. It has not been possible to evaluate the instrument based on a scale or test that acts as a gold standard.
(Cerminaro et al., 2022) (7)	Automatic Ingestion Monitor (AIM-2) for infant feeding assessment	Breastfeeding infants ≤7 months (excluding twins and higher-order births)	Compare infant feeding assessment (frequency, duration, and cues) by self-report and AIM-2	Caregiver-reported infant feeding practices, breastfeeding experiences, demographic information (occupation, education, marital status, among others)	Utilizes a mixed-methods approach with a diverse dataset, making it feasible for infant feeding assessment. Does not directly measure breastmilk intake.	lacks the ability to directly measure the intake of breastmilk

Author, Year	Tool Name	Target Group	Purpose/Objective	Key Parameters Measured	Advantages/Strengths	Limitations
(Corsini et al., 2018)(8)	Child Feeding Questionnaire Restriction subscale	Toddlers excluding those with specific medical conditions	Examine the association between Restriction (Child Feeding Questionnaire) and EAH in toddlers	Parental restriction, children's frequency of snack food consumption, toddler's attraction, parent and toddler BMI	Although limited by sample size, it provides insights into the association between parental restriction and child eating behavior in a controlled environment. Typical dietary behavior may be affected by an unfamiliar environment.	The sample size may have been too small to detect real effects; Children's typical dietary behaviour may have been affected by the unfamiliar environment
(Desalegn et al., 2019) (9)	Feeding Practices questionnaire	Healthy breastfeeding children aged 6–23 months	Assess and compare the feeding practices and nutritional status of fasting and non-fasting lactating mothers' children during Ethiopian Orthodox lent fasting and non-fasting periods	Socio-demographic and economic characteristics, maternal and child characteristics, water, sanitation, and health (WASH), feeding practices, household food insecurity information, anthropometry, nutritional status	Considers only the lent fasting period and includes only children aged between 6–23 months.	considered only the lent fasting period, included only children aged between 6–23 months
(Ehrmann et al., 2018) (10)	Systematic Feeding Readiness Assessment (FRA)	Infants admitted for their first cardiac surgery	Predict protracted feeding difficulties early during hospitalization using FRA	Infant feeding skills, demographics (including gender, prematurity, diagnosis), peri-/ postoperative data	Provides a shared mental model for assessing feeding progress and identifying high-risk infants. Doesn't explore other causes of supplemental tube feedings. Single-center retrospective analysis limits generalizability.	single center retrospective analysis, which by its design limits easy generalizability, other reasons for needing supplemental tube feedings at discharge not related to feeding skills (eg, aspiration) were not explored, did not account for all methods of discharge supplemental tube feeding
(Fries et al., 2019)(11)	Caregiver's Feeding Style Questionnaire (CFSQ)	Families with annual income >\$30,000, English-speaking households	Assess whether feeding questionnaire responses reflect observed mealtime behavior	Feeding behavior questionnaires, coded videos of children's dinner meals	Provides insight into the alignment of questionnaire responses and observed behavior. Self-reports of "sometimes" performing a behavior may have limited predictive utility. Limited to a single dinner meal comparison.	Self-reports of "sometimes" performing a behavior may have limited utility for prediction of behavior and likely requires additional exploration with the respondent. reflect a comparison between a single dinner meal and questionnaires designed to measure general feeding practices

Author, Year	Tool Name	Target Group	Purpose/Objective	Key Parameters Measured	Advantages/Strengths	Limitations
(Fucile and Dow, 2022) (12)	The Nipple Monitoring Tool	Infants without severe medical complications, appropriate size for their GA, receiving tube feedings	Test the clinical utility and safety of a nipple monitoring device for oral feeding skills evaluation	Oral feeding performance (duration, intake volume, rate), occurrence of adverse events (apnea, bradycardia, desaturations)	Unique, safe, and family-centered tool for quantitative oral feeding assessment and intervention planning. Tested during one oral feed with stable infants, which limits clinical generalizability. Small sample size.	only tested during one oral feed, with infants who were clinically stable, and sample size was small, which limits clinical generalizability
(Guivarch et al., 2022) (13)	Three-Factor Eating Questionnaire (TFEQ-R21)	Toddlers	Study associations between maternal eating behaviors and feeding practices in toddlerhood	Maternal eating behaviors, feeding practices in toddlerhood	Assesses maternal eating behaviors and feeding practices and provides insights into familial transmission of eating behaviors. Low Cronbach's alpha for food as a reward. Limited generalizability.	- Low Cronbach's alpha for food as reward - Limited generalizability to other cultures and populations
(Heerman et al., 2018) (14)	Toddler Feeding Questionnaire (TFQ)	Parent-preschool child pairs	Confirm the reliability and validity of the TFQ for measuring parental feeding practices among Spanish-speaking parent-preschool child pairs.	Parent characteristics (BMI, stress, health literacy)	Valid measure of authoritative and indulgent parent feeding practices. Associated with unhealthy parent feeding practices among high-risk population.	N/A
(Hill et al., 2022)(16)	Neonatal Eating Assessment Tool-Bottle-feeding (NeoEAT-Bottle-feeding)	Preterm-born infants	Describe symptoms of problematic bottle-feeding in infants born preterm, compared to full-term infants.	Bottle-feeding, age, presence of gastroesophageal reflux, face/mouth anomalies	Comprehensive assessment of bottle-feeding difficulties, enables comparison of scores between preterm categories. Small sample sizes, reliance on parent-report data.	- Small sample sizes for preterm-born infants - Reliance on parent-report for data collection
(Hill et al., 2020) (16)	Neonatal Eating Assessment Tool (NeoEAT) version (Breastfeeding, Bottle-Feeding, or Mixed Feeding)	Infants with tongue-tie	Describe symptoms of problematic feeding in infants with tongue-tie, evaluate changes in non-nutritive suck measures before and after frenotomy, and examine tongue-tie severity with changes in non-nutritive suck patterning.	Non-nutritive suck measures, tongue-tie severity, infant behavioral state	Comprehensive measure of infant feeding, able to identify problematic feeding. Limited generalizability due to small and homogenous sample.	- Small and homogenous sample - Cannot generalize findings to larger population

Author, Year	Tool Name	Target Group	Purpose/Objective	Key Parameters Measured	Advantages/Strengths	Limitations
(Hines et al., 2022) (17)	Breastfeeding Self-Efficacy Scale-Short Form and Neonatal Eating Assessment Tool– Breastfeeding and Bottle-feeding scales	Full-term infants at 3 months	Identify effects of birth order on breastfeeding self-efficacy, parental-report of infant feeding behaviors, infant non-nutritive sucking and oral feeding skills in full-term infants at 3 months.	Non-nutritive sucking and feeding performance	Identifies levels of breastfeeding self-efficacy in mothers, allows for comparison between primipara and multipara mothers. Subjectivity in self-report questionnaires. Relatively homogenous sample.	- Subjectivity in self-report questionnaires - Relatively homogenous sample
(Hyczko et al., 2021) (18)	Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) Study	Infancy and early childhood	Explore sex differences in maternal feeding practices during infancy and early childhood in the INSIGHT cohort and examine whether RP intervention effects on maternal feeding practices differed by child sex.	Early life responsive parenting intervention	Assesses feeding beliefs and behaviors among parents, measures various feeding style domains. N/A	N/A
(Iqbal et al., 2022) (19)	Infant Breastfeeding Assessment Tool (IBFAT)	Kangaroo mother care and conventional care in newborns	Compare kangaroo mother care with conventional care in newborns regarding the frequency of successful first breastfeeding and time to initiate breastfeeding.	Frequency of successful first breastfeeding, time to initiate breastfeeding	Increased success of first breastfeeding with KMC, decreased time to establish lactation with KMC. N/A	N/A
(Jansen et al., 2021) (20)	Feeding Practices and Structure Questionnaire (FPSQ)	Infants and toddlers < 2 years of age	Modify the FPSQ for infants and toddlers (< 2 years) and test the factorial validity of age-appropriate versions of the FPSQ for milk-fed and solid food-fed infants.	Feeding practices related to non-responsiveness and structure across childhood	High standardized factor-loadings, single-item indicators reduce participant burden. No validation in diverse samples and contexts, no examination of relationships with infant eating behavior or weight.	- No validation in diverse samples and contexts. - No examination of relationships with infant eating behavior or weight.
(Kamran et al., 2020) (21)	Preterm Infant Oral Feeding Readiness Assessment Scale (PIOFRAS)	Effectiveness of cue-based feeding in preterm infants	Investigate the effectiveness of cue-based feeding in preterm infants, compare with scheduled feeding.	Duration of full oral feeding achievement, duration of hospitalization	Cue-based feeding achieved full oral feeding sooner, led to earlier discharge. Limited details about specific assessment tools used.	Limited details about the specific assessment tools used

Author, Year	Tool Name	Target Group	Purpose/Objective	Key Parameters Measured	Advantages/Strengths	Limitations
(Kim et al., 2021) (22)	Behavioral Pediatrics Feeding Assessment Scale (BPFAS)	Toddlers	Investigate the effect of sensory-based feeding treatment for toddlers with food refusal, compare with nutrition education alone. Evaluate if sensory-based feeding intervention improves mealtime behavior.	Behavior at mealtime (BPFAS), sensory processing (Infant/Toddler Sensory Profile)	Effective in improving mealtime behavior in toddlers with food refusal. No direct comparison with other assessment tools.	No direct comparison with other assessment tools
(Kwon et al., 2020) (23)	Neonatal Eating Outcome Assessment - Pediatric Eating Assessment Tool (PediEAT)	Neonatal feeding; Feeding outcomes in childhood	Define relationships of early feeding performance with feeding outcomes in childhood, assess predictive validity of the Neonatal Eating Outcome Assessment.	Neonatal Eating Outcome Assessment, Pediatric Eating Assessment Tool	Neonatal Eating Outcome Assessment has established predictive validity. Limited information about other assessment tools used.	Limited information about other assessment tools used
(Lei et al., 2022) (24)	Infant and Child Feeding Index (ICFI)	Infants and young children aged 7-24 months	Assess reliability and validity of FFQ and feeding index, evaluate questionnaire's limitations.	Maternal mental health, infant feeding behaviors	Reveals potential relationship between maternal mental health and feeding behaviors in infants with colic. Limited details about specific assessment tools used.	Limited details about specific assessment tools used
(Lovell et al., 2021) (25)	Eating Assessment in Toddlers FFQ (EAT FFQ) - GUMLi EAT FFQ	Children under 2 years	Re-assess the validity of the EAT FFQ, estimate calibration factors in GUMLi trial subsample.	Nutrient intakes, BMI	Useful tool for ranking nutrient intakes, comparative validity with other FFQ, calibration with 24HR data. Limited information about other assessment tools used.	Limited information about other assessment tools used
(Martens et al., 2023) (26)	Infant-Toddler Home Observation for Measurement of Environment Inventory (IT-HOME)	Early childhood nutrition	Examine the relationship between the home environment and infant bottle feeding outcomes at 3 and 12 months of age. Determine the role the home environment plays in bottle feeding outcomes within the first year of life.	Dietary quality, BMI	Provides insights into early childhood nutrition's impact on later BMI. Limited information about specific assessment tools used.	Limited information about specific assessment tools used

Author, Year	Tool Name	Target Group	Purpose/Objective	Key Parameters Measured	Advantages/Strengths	Limitations
(Pados et al., 2019) (27)	Neonatal Eating Assessment Tool - Mixed Breastfeeding and Bottle-Feeding (NeoEAT - Mixed Feeding)	Feeding behavior	Factor analysis and psychometric properties of NeoEAT - Mixed Feeding	Feeding behavior	Assesses feeding behavior in mixed feeding situations, psychometric properties. Limited information about other assessment tools used.	Limited information about other assessment tools used
(Park et al., 2018) (28)	PediEAT (Pediatric Eating Assessment Tool)	Problematic eating symptoms	Develop and evaluate system architecture for pediatric feeding assessments via telepractice.	Acceptability to users, completion of typical pediatric feeding assessments	Acceptable to users, enabled completion of pediatric feeding assessments. Lack of focus on user-acceptability and system design, need for further research on delivering synchronous feeding assessments via telepractice.	Small sample size with heterogeneous target children. 6 months may be too short to see change in chronic feeding problems. Reliance on parent report for symptom assessment, potential recall bias, limited assessment tools used.
(Raatz et al., 2019) (29)	System Architecture for Synchronous Paediatric Feeding Assessments	N/A	Develop and evaluate system architecture for pediatric feeding assessments via telepractice.	Acceptability to users, completion of typical pediatric feeding assessments	Acceptable to users, enabled completion of pediatric feeding assessments. Lack of focus on user-acceptability and system design, need for further research on delivering synchronous feeding assessments via telepractice.	- Lack of focus on user-acceptability and system design - Need for further research on delivering synchronous feeding assessments via telepractice
(Raatz et al., 2021) (30)	Telepractice for Bottle-Feeding Assessments	Bottle-feeding skills	Investigate the inter-rater reliability of bottle-feeding assessments via synchronous telepractice (real-time videoconferencing) and assess parent and clinician satisfaction.	Developmental level, state, color, respiration, oral motor skills, infant oral reflexes, tongue tie (screen only), non-nutritive suck, bottle-feeding, overall feeding skills, recommendations	Majority of clinical bottle-feeding assessment elements completed reliably via telepractice model, acceptable to parents and service providers. Limitations of synchronous (real-time) study design. Potential bias in satisfaction and perceptions data.	- Limitations of synchronous (real-time) study design - Potential bias in satisfaction and perceptions data
(Ruggiero et al., 2020) (31)	Babies Need Soothing Questionnaire, Infant Feeding Styles Questionnaire, Structure and Control in Parent Feeding Questionnaire	First-time mother-infant dyads	Examine the spillover effect of responsive parenting intervention on maternal feeding practices with secondborn infants, test moderating effect of birth spacing.	Feeding practices for second-born infants	RP intervention prevented nonresponsive, controlling feeding practices, promoted structure-based feeding. No differences in bottle-feeding practices, birth spacing did not moderate intervention effects.	No differences observed in bottle-feeding practices, and birth spacing did not moderate intervention effects.

Author, Year	Tool Name	Target Group	Purpose/Objective	Key Parameters Measured	Advantages/Strengths	Limitations
(Russell et al., 2018) (32)	Baby Eating Behavior Questionnaire (BEBQ)	Parents of infants	Determine effects of a mobile health (mHealth) intervention on parental feeding, infant food preferences, and satiety responsiveness. Compare intervention group with a non-randomized comparison group.	Parental feeding practices, infant food preferences, infant satiety responsiveness	mHealth offers low cost and easy access, tailored content for promoting healthy infant feeding. Quasi-experimental design, participants not randomly assigned, differences between intervention and comparison groups at baseline.	- Quasi-experimental design, participants not randomly assigned - Differences between intervention and comparison groups at baseline
(Thoyre et al., 2018a) (33)	NOMAS (Neonatal Oral-Motor Assessment Scale) - EFS (Early Feeding Skills)	Infants	Assess and document objective markers of feeding skill progression, examine infant feeding skills through behavior and physiologic stability.	Stable oxygen saturation, stable heart rate	Validity and reliability of the EFS tool, five subscales derived from factor analysis. Sample primarily consisted of premature infants. Need for a larger and more diverse sample.	- Sample primarily consisted of premature infants. - Need for larger and more diverse sample.
(Thoyre et al., 2018b) (34)	Pediatric Eating Assessment Tool (PediEAT)	Children aged 6 months to 7 years	Identify the factor structure of PediEAT, test its psychometric properties.	Behavioral and physiologic symptoms of feeding problems	Valid and reliable measure for research and clinical practice, excellent internal consistency. Parent report of child feeding diagnosis not confirmed by medical record. Sensitivity of scoring system at lower age range may be limited.	- Parent report of child feeding diagnosis not confirmed by medical record - Lack of sensitivity of scoring system at lower age range
(Zakria et al., 2019) (35)	Infant and Young Child Feeding Questionnaire (IYCF-CCPQ)	Child care providers in Malaysia	Validate IYCF-CCPQ questionnaire on infant and young child feeding in Malaysia, assess knowledge, attitudes, and practices among child care providers in registered centers.	Difficulty index, discrimination parameter	Tailored to the cultural background of respondents, provides better information specific to child care providers in Malaysia. Good psychometric properties and reliability. N/A	N/A

TYPES OF TOOLS FOR DIFFERENT AGES AND TARGET GROUPS

For Premature Infants:

- The **Early Feeding Skills (EFS) scale**, as presented by (5), is a valuable tool meticulously designed for premature newborns. It comprehensively assesses various aspects of

their feeding process, offering crucial insights into feeding challenges within this vulnerable group.

- In a similar context, the **Oral Feeding Assessment in premature infants (OFEATING) instrument**, introduced by (6), focuses on validating oral feeding skills in preterm infants admitted to Neonatal Intensive Care Units (NICUs). This tool plays a pivotal role in assessing critical oral func-

tions that significantly impact feeding readiness among premature infants.

For Toddlers:

- Several assessment tools provide valuable insights into feeding behaviors and the influence of parents on toddlers. The **Child Feeding Questionnaire Restriction subscale**, as developed by (8), explores the associations between parental restriction and eating habits in toddlers.
- In a different perspective, the **Three-Factor Eating Questionnaire (TFEQ-R21)**, as detailed by (37), delves into maternal eating behaviors and their potential impact on feeding practices during toddlerhood.
- Furthermore, the **Behavioral Pediatrics Feeding Assessment Scale (BPFAS)**, elucidated by (22), adopts a sensory-based approach to address food refusal in toddlers, with a particular emphasis on mealtime behavior.

For Infants and Young Children:

- The **Infant and Child Feeding Index (ICFI)**, introduced by (24), assesses feeding behaviors in infants and young children aged 7-24 months. This tool provides a unique perspective on how maternal mental health can influence feeding practices in infants, particularly those with colic.
- The **Eating Assessment in Toddlers FFQ (EAT FFQ)**, detailed by (25), targets children under 2 years, specifically during the latter part of their second year of life. Researchers have employed this tool to gauge nutrient intake and calibrate it against other dietary assessment methods.
- In a broader context, the **Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) Study**, as conducted by (18), explores feeding beliefs and behaviors among parents during infancy and early childhood. This extensive study encompasses a range of feeding style domains.

For Children without Specific Risk Factors:

- A variety of tools cater to children without specific risk factors. The **Automatic Ingestion Monitor (AIM-2)**, as discussed by (7), investigates infant feeding practices, including frequency, duration, and cues, especially for breastfeeding infants up to 7 months.
- The **Caregiver's Feeding Style Questionnaire (CFSQ)**, presented by (11), delves into the alignment of questionnaire responses with observed mealtime behavior among families with annual incomes above \$30,000, specifically in English-speaking households.
- In a diverse context, the **Infant Breastfeeding Assessment Tool (IBFAT)**, highlighted by (19), compares kangaroo

mother care with conventional care in newborns, focusing on the frequency of successful first breastfeeding and the time to initiate breastfeeding.

- Moving on, the **Feeding Practices and Structure Questionnaire (FPSQ)**, as detailed by (38), has been modified for infants and toddlers below 2 years. This modification aims to assess feeding practices related to non-responsiveness and structure throughout early childhood.
- Furthermore, the **Babies Need Soothing Questionnaire, Infant Feeding Styles Questionnaire, and Structure and Control in Parent Feeding Questionnaire**, as discussed by (39), investigate the spillover effect of responsive parenting intervention on maternal feeding practices with second-born infants.
- The **Baby Eating Behavior Questionnaire (BEBQ)**, introduced by (36), assesses parental feeding practices, infant food preferences, and satiety responsiveness through a mobile health (mHealth) intervention.

For Children at Risk of a Disease or with a Disease:

- Tools such as the **Systematic Feeding Readiness Assessment (FRA)**, as conducted by (10), predict protracted feeding difficulties in infants admitted for their first cardiac surgery.
- Additionally, **Telepractice for Bottle-Feeding Assessments**, explored by (28), evaluates bottle-feeding skills, making it particularly relevant for infants at risk or with certain medical conditions.

These assessment tools, each with its unique focus and application, contribute significantly to our understanding of infant and child feeding across various age groups and risk profiles. Researchers and healthcare practitioners can refer to these tools to tailor their assessments according to specific needs and populations.

Common Limitations of Infant and Child Feeding Assessment Tools (Table 2)

Table 2 elucidates the common limitations inherent in many infant and child feeding assessment tools. Recognizing these limitations is vital for researchers and clinicians when interpreting their findings:

- **Small Sample Sizes:** Numerous assessments were conducted with limited participant numbers, raising concerns about generalizability (5, 40, 41).
- **Lack of Validation:** Several tools were not validated against gold standards, questioning their reliability and accuracy (6, 10, 42).

- **Limited Generalizability:** Homogeneous sample populations in some studies limited the applicability of findings to broader demographics (17, 43).
- **Subjectivity in Self-Reports:** Self-report questionnaires introduced subjectivity into data collection processes (44, 45).
- **Single-Meal Comparisons:** Conclusions based on single-meal comparisons may not capture the full spectrum of feeding behaviors (11, 43).
- **Cultural and Contextual Specificity:** Some tools demonstrated cultural and contextual specificity, potentially limiting their use in diverse settings (35, 37).
- **Inadequate Validation in Diverse Samples:** Limited validation in diverse samples and contexts raised questions about the tools' universality (38).
- **Reliance on Parental Report:** Heavy reliance on parental reports in some assessments introduced potential recall bias. Understanding these common limitations is paramount for interpreting infant and child feeding assessment tool results effectively, allowing researchers and clinicians to make informed choices based on their specific research objectives and target populations.

DISCUSSION

The comprehensive overview of assessment tools for evaluating infant and child feeding practices presented in this review underscores the diversity of instruments available to researchers and healthcare professionals (Table 2). These tools serve a crucial role in understanding and addressing feeding-related challenges across various age groups and populations. In this discussion, we delve into several key themes and considerations arising from the analysis of the selected studies.

1. Tailoring Assessment Tools to Target Populations

One striking observation is the need to select assessment tools carefully based on the target population and research objectives. As evident from Table 2, tools like the "Early Feeding Skills (EFS) scale" (5) and the "Oral Feeding Assessment in premature infants (OFEATING) instrument" (6) are specifically designed for premature infants without neurological damage or craniofacial malformations. These tools provide valuable insights into the oral feeding readiness and skills of this vulnerable group. Researchers and clinicians working with premature infants should consider these specialized tools to obtain a comprehensive assessment of their unique feeding challenges.

Similarly, for toddlers, tools like the "Child Feeding Questionnaire Restriction subscale" (8), "Three-Factor Eating

Questionnaire (TFEQ-R21)" (37), and "Behavioral Pediatrics Feeding Assessment Scale (BPFAS)" (22) offer tailored approaches to understanding feeding behaviors and parental influences during this critical developmental stage.

Conversely, instruments such as the "Infant and Child Feeding Index (ICFI)" (24) and the "Eating Assessment in Toddlers FFQ (EAT FFQ)" (25) cater to infants and young children aged 7-24 months, providing insights into feeding practices and dietary quality in this age group.

2. Consideration for At-Risk Populations

Several studies focus on at-risk populations or those with specific diseases, emphasizing the importance of identifying areas for intervention and support. For example, the "Three-Factor Eating Questionnaire (TFEQ-R21)" and the "Toddler Feeding Questionnaire (TFQ)" explore maternal eating behaviors and parental feeding practices among at-risk populations. These assessments play a crucial role in understanding how specific risk factors or medical conditions can influence feeding dynamics.

Additionally, tools like the "Systematic Feeding Readiness Assessment (FRA)" (10) and "Telepractice for Bottle-Feeding Assessments" (28) are designed to evaluate feeding difficulties in infants with medical conditions, offering valuable insights for healthcare professionals working with this demographic.

3. Sample Sizes and Age Ranges

The variation in sample sizes and age ranges across the selected studies highlights the importance of considering the generalizability of findings. Studies like the "Neonatal Eating Assessment Tool-Bottle-feeding (NeoEAT-Bottle-feeding)" (42) with a substantial sample of 625 infants aged 0-7 months provide robust data but may have limited applicability to older age groups. Conversely, studies with smaller sample sizes, such as the "The Nipple Monitoring Tool" (12) may offer more specialized insights but with reduced generalizability.

Researchers should carefully assess their study population and research objectives to determine whether the selected assessment tool aligns with the age range and sample size of their participants.

4. Strengths and Limitations of Assessment Tools

The strengths and limitations of assessment tools should be considered when interpreting study findings. Common strengths among the studies reviewed include contributions to the validation and reliability of assessment tools. These efforts enhance the credibility of the instruments and their utility in research and clinical settings.

However, it's important to acknowledge the shared limita-

tions, such as small sample sizes, lack of validation against gold standards, cultural and contextual specificity, and reliance on self-report data. Researchers and clinicians should exercise caution when applying these tools and be aware of their inherent limitations. Additionally, future research should aim to address these limitations by conducting validation studies in diverse populations and exploring alternative measurement methods to complement self-report data.

5. Practical Implications and Future Directions

The diverse range of assessment tools showcased in this review offers practical implications for researchers and healthcare practitioners. By selecting the most appropriate tool for their specific study population and objectives, researchers can enhance the quality of their research and contribute to a deeper understanding of infant and child feeding practices.

Future directions in this field should involve the refinement and validation of assessment tools to improve their accuracy and applicability across diverse populations. Additionally, exploring innovative technologies and measurement approaches can address some of the limitations associated with self-report data.

CONCLUSION

This review provides a comprehensive overview of assessment tools for infant and child feeding practices, emphasizing the need for tailored approaches based on target populations and research objectives. Researchers and healthcare professionals can leverage these tools to advance our understanding of feeding dynamics and develop targeted interventions to support healthy feeding practices in early childhood.

CONFLICTS OF INTEREST

None.

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