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Systematic Review

Systematic Review: Mealtime Behavior Measures Used in Pediatric Chronic Illness Populations

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Abstract

Objective This systematic review evaluates the utility and psychometric properties of pediatric mealtime assessments (direct observation and parent-report measures) using evidence-based criteria developed by the Division 54 Evidence-Based Assessment Task Force. **Method** Measures of mealtime behavior used in at least one chronic illness pediatric population were eligible for inclusion. A total of 23 assessment measures were reviewed (16 parent-/self-report; 7 direct observation). **Results** 3 parent-report and 4 direct observation measures were classified as *well-established*, 3 met criteria for *approaching well-established*, and 13 were categorized as *promising*. Measures have been primarily used in children with feeding disorders, cystic fibrosis, and autism spectrum disorders. **Conclusions** Overall, the literature of pediatric mealtime assessment tools shows a strong evidence base for many direct observation methods and subjective parent-report measures. Exploratory and confirmatory factor analyses are available for some measures; recommendations for future validation research and measure development across pediatric populations are discussed.

Key words: children; chronic illness; eating and feeding disorders; systematic review.

Introduction

Approximately 25% of children have a feeding or eating problem at some point during childhood (Manikam & Perman, 2000), making feeding problems a frequent referral issue in both inpatient and outpatient settings. An array of difficulties arise for parents and children when feeding is disrupted (Davies, Ackerman, Davies, Vannatta, & Noll, 2007), including increased parenting stress (Powers et al., 2002), lengthier mealtimes, and strained parent–child mealtime interactions (Crist & Napier-Phillips, 2001). Often, an underlying medical or behavioral diagnosis is related to the type of feeding problem. For example, problems with dietary restrictions, such as refusal to eat certain foods or selective food preference, are often associated with children with autism spectrum disorder (ASD; Seiverling, Williams, & Sturmey, 2010), while children with cystic fibrosis (CF) may resist eating large quantities of food or foods high in caloric content (Janicke, Harman, Kelleher, & Zhang, 2008). Another illustration is the parental stress, disruptive child mealtime behavior, and ineffective parent behavior reported among parents of children with type 1 diabetes mellitus (T1DM; Patton, Dolan, & Powers, 2006). Overall, regardless of feeding disorder or etiology of problem feeding behaviors, increased resistance to eating and a disturbance in the feeding relationship are often observed (Berlin, Davies, Silverman, & Rudolph, 2011). Because of the variety of

feeding problems children may demonstrate, use of appropriate pediatric assessments is critical.

Mealtime behavior among families has been increasingly studied over the past 20 years. As part of this growing trend, the number of assessment measures, both direct observation and questionnaires, has also increased. Researchers have developed questionnaires to assess mealtime routines, attitudes, and food practices, as quick and clinically useful assessments (Patton et al., 2006). While more labor-intensive, direct observation methods are also available for naturalistic observation of family mealtimes. Previous reviews have examined the variety of assessments available to community samples (Vaughn, Tabak, Bryant, & Ward, 2013). In many cases, these community-developed assessments have been adapted for use in chronic illness populations, despite the absence of psychometric properties in these children (Quittner, 2000). Additionally, a number of assessments have been developed to specifically target behaviors unique to pediatric chronic illness populations (e.g., ASD; Hurley, Cross, & Hughes, 2011; Seiverling et al., 2010). To date, a review of the use and utility of all mealtime assessments (direct observation and questionnaires) used in pediatric chronic illness populations has not been conducted. A cohesive, comprehensive review would help guide clinicians and researchers in their selection of a tool based on their population of interest, research question, and the tool's psychometric properties. The current review describes the assorted mealtime assessments used in pediatric chronic illness populations and discusses their evidence base and psychometric support. In this review, pediatric chronic illness is defined as children with any special health care needs (Child and Adolescent Health Measurement Initiative, 2013). Therefore, children with ASD, feeding disorders, and various chronic illnesses have been included to capture the full scope of mealtime behaviors that families may face when children present with special health care needs.

Measure Selection

Articles were identified from two databases (PsychInfo, PubMed) using the search terms "mealtime behavior measure" and "child." This initial search yielded 253 articles. Then, inclusion criteria were applied to further reduce the sample of articles. To be included in the review, articles had to meet the following criteria: (a) published (or available with advanced access) in a peer-reviewed journal through January 2014, (b) originally developed for use in children, (c) used in at least one chronic illness population, (d) assessment that occurred in the home or research setting, (e) inclusion of parent and/or child mealtime behaviors, and (f) published in English. Articles were screened by two independent raters (K.P. and K.B.), and interrater reliability was strong (kappa: .877). A total of 43 articles met inclusion criteria and then forward/backward searches of included measures were conducted. In the case of discrepancies in inclusion/exclusion, both raters discussed until an agreement was reached. Twenty articles were excluded, as they failed to provide information about the mealtime behavior assessment measure or did not include a chronic illness population. A final sample of 23 measures was identified for inclusion in the review.

Framework and Assessment Criteria

As recommended by the Society of Pediatric Psychology Assessment Task Force (Cohen et al., 2008) and used by previous researchers (Lewandowski, Toliver-Sokol, & Palermo, 2011), evidence-based criteria were used to assess and evaluate the research and clinical utility of each measure. These criteria were based on (a) the availability of reliability and validity data, (b) the use of the measure by multiple investigatory teams, (c) the number of pediatric populations in which the measure had been used, and (d) the presentation of the measure in a peer-reviewed journal. Using these criteria, measures were classified into three categories: (a) *well-established*, (b) *approaching well-established*, and (c) *promising*. See Table I for descriptions of these terms (for a more extensive review, see [Cohen et al., 2008]). When considering the psychometric properties of the measures, categorization was based on the statistical analyses reported by the authors in their original peer-reviewed manuscript. Tables II–IV describe each measure in this review, provide their psychometric properties, and provide the evidence-based assessment (EBA) rating. Within the text, information about the chronic illness population is provided, as well as treatment implications and diversity information, if available. Articles were divided into two major categories, parent-report measures and direct observation measures, and arranged in an alphabetical order within each section.

Parent-Report Measures

Measures range in focus from parental attributions of problematic mealtime behaviors to an evaluation of parents' response to their child's mealtime behaviors. There are a few measures that focus specifically on parents' attitudes and beliefs about mealtimes in addition to specific feeding behaviors. In contrast, there are some measures that offer an in-depth analysis of specific child behavior during mealtime.

About Your Child's Eating—Revised

About Your Child's Eating—Revised (AYCE-R; Davies, Noll, Hobart Davies, & Bukowski, 1993) is a 25-item parent-report measure that has been validated in children aged 2–16 years. The original AYCE identified two subscales, Negative and Positive Mealtime Interactions; however, later factor analyses yielded three scales: Child Resistance to Eating, Positive Mealtime Environment, and Parent Aversion to Mealtime (AYCE-R; Davies et al., 2007). Although the AYCE was originally used in children with sickle–cell disease, later samples have included a broadly defined chronically ill population (Berlin et al., 2011; Davies et al., 2007), pediatric cancer patients (Gerhardt et al., 2006), children with single ventricle following staged palliation (Hill et al., 2013), and obese children (Stark et al., 2011; Zeller et al., 2007). The AYCE has also been used to validate two other measures, including the Feeding Strategies Questionnaire (FSQ; Berlin et al., 2011) and the Mealtime Behavior Questionnaire (MBQ; Berlin et al., 2010).

In a sample of children treated for overweight, Stark et al. (2011) noted a significant decrease in the Aversion to Mealtime scale in the treatment group, whereas the standard control group reported an increase on this scale, demonstrating that the AYCE-R is sensitive to change in obese populations (Boles, Scharf, & Stark, 2010; Stark et al., 2011). Similarly, children with gastrostomy tube-dependency experienced a significant decrease following participation in a behavioral treatment program (Silverman et al., 2013). Children with single ventricle following staged palliation were significantly more resistant to eating when compared with healthy peers, and increased parental aversion to mealtime was also noted in this sample (Hill et al., 2013). However, despite favorable results in several populations, the AYCE-R has failed to distinguish between cancer and comparison groups, and it has not proven to be sensitive

Table I. Criteria for Classification

Well-established	Published by different investigators or investigatory teams in at least two peer-reviewed journals Demonstration of good psychometric properties through inclusion of statistics in at least one peer-reviewed journal Utilization and presentation of psychometric properties in at least two chronic illness populations
Approaching well-established	Measure is published in two peer-reviewed journals by at least one investigator/investigatory team Demonstration of adequate psychometric properties or statistics reported with presenting the statistical analyses necessary for replication Used in at least two chronic illness populations
Promising	Published in at least one peer-reviewed journal Presentation of psychometric properties without an explanation of statistical methodology used or moderate support for reliability and validity Used in at least one chronic illness population

Note. Adapted from Cohen et al., 2008.

Table II. Well-Established Measures

	Age range	Number of items	Factor analysis	Interrater reliability
Parent-report measures				
About Your Child's Eating—Revised	2–16 years	25	CFA Obesity .69–.82 Chronic illness .66–.86 Sickle–cell disease .74–.89 Feeding .78–.87 CS .75–.90 EFA Chronic illness .72–.89 Cancer .70–.95	
Behavioral Pediatrics Feeding Assessment Scale	6 months–12 years	35	CFA Feeding .76–.78 CF .74–.88 Obesity .65–.78 T1DM .72–.87 ASD .77 EFA T1DM .68–.79 Obesity .41–.95	
Mealtime Behavior Questionnaire	2–6 years	33	EFA CS .49–.81 CFA CS .73–.91	
Direct observation schedules				
Dyadic Interaction Nomenclature for Eating	7 months–12 years			CF K .57–1.0; T1DM K .65–.90
The Feeding Scale	1–37 months		FA Feeding .34–.85	Feeding ICC .82–.92
Mealtime Family Interaction Coding System	1–13 years		EFA Overweight .49–.78	Loss of control eating ICC .96–.97 Asthma ICC .76–.94 Overweight w/Asthma ICC .72–.85 CF ICC .62–.93 Overweight 74–.92
Mealtime Observation Schedule	1–6 years			Feeding problems K .50–.99 CF K .71–.77

Note. CFA = confirmatory factor analysis; EFA = exploratory factor analysis; FA = factor analysis; K = Cohen's kappa coefficient; ICC = intraclass correlation; CS = community sample; ASD = autism spectrum disorder; T1DM = Type 1 diabetes mellitus; values represent factor loadings.

to differences in child's age, sex, time since diagnosis, or treatment severity (Gerhardt et al., 2006). Overall, the AYCE-R is judged as *well-established*, but caution is recommended when using the AYCE-R in cancer patients, as the factor structure has not proven to be stable across child groups.

Brief Autism Mealtime Behavior Inventory/Brief Assessment of Mealtime Behavior in Children

Lukens and Linscheid (2008) developed the Brief Autism Mealtime Behavior Inventory (BAMBI) as the first measure to assess

Table III. Approaching Well-Established Measures

	Age range	Number of items	Factor analysis
Parent-report measures			
Brief Autism Mealtime Behavior Inventory	3–11 years	18	CFA ASD .61–.88 Hospital feeding clinic w/ & w/o ASD .35–.76
Children's Eating Behavior Inventory	6 months–12 years	40	CFA ASD .58–.76
Comprehensive Feeding Practices Questionnaire	1–8 years	49	CFA CS .58–.87 EFA Obesity .63–.90

Note. CFA = confirmatory factor analysis; EFA = exploratory factor analysis; CS = community sample; ASD = autism spectrum disorder; values represent factor loadings.

ASD-specific mealtime behavior problems in children 3–11 years old. The BAMBI has three factor scores: Limited Variety, Food Refusal, and Features of Autism. Unfortunately, in a sample of children with and without ASD presenting to a hospital feeding clinic, psychometric findings suggest that the BAMBI has only poor to adequate internal consistencies among the factor scores. When used in a sample consisting solely of children with ASD, the psychometric properties improve and demonstrate internal consistencies that range from acceptable to good (Lukens & Linscheid, 2008). The BAMBI has been used in conjunction with the Food Preference Inventory, as well as a direct observation schedule, with findings indicating that the Limited Variety subscale similarly assesses the construct of food selectivity (Sharp, Jaquess, & Lukens, 2013). However, the Features of Autism subscale did not significantly correlate with the Social Responsiveness Scale, which may indicate that further investigation of this subscale is warranted (Sharp, Jaquess, & Lukens, 2013). As a result, the BAMBI is categorized as *approaching well-established*.

The mixed psychometrics on the BAMBI led to later development of the Brief Assessment of Mealtime Behavior in Children (BAMBIC; Hendy, Seiverling, Lukens, & Williams, 2013), a measure designed for more wide-scale generalizability and clinical utility. Factor analysis of the BAMBIC suggests three subscales of feeding problems: Limited Variety, Food Refusal, and Disruptive Behavior. The BAMBIC has been used in children aged 18 months to 17 years, thus providing clinicians and researchers with a unique assessment tool that may be used across a child's development. In a sample of typically developing and clinical children (i.e., ASD and special needs) with feeding problems, the BAMBIC distinguished between gender (e.g., boys evidenced more Limited Variety compared with girls), age (e.g., Food Refusal scores were higher in younger children), and diagnosis (e.g., children with special needs were higher on Food Refusal and their parents were more permissive and engaged in more positive persuasion to encourage eating; Hendy et al., 2013). To date, only the research team that created the BAMBIC has published results in a peer-reviewed journal, and its subscales show adequate internal consistency, resulting in the classification of *promising*.

Behavioral Pediatrics Feeding Assessment Scale

The Behavioral Pediatrics Feeding Assessment Scale (BPFAS; Crist et al., 1994) was originally designed to assess parent and child behavior at mealtimes for families of children with CF. The BPFAS has two scores that reflect the frequency of child behaviors and number of problematic child behaviors, and two scores that reflect the frequency of parent behaviors and number of problematic parent behaviors. One study has found significant agreement on several parent and child mealtime behaviors between the BPFAS and the Dyadic Interaction Nomenclature for Eating (DINE; Piazza-Waggoner, Driscoll, Gilman, & Powers, 2008; Powers et al., 2005; Stark et al., 1995, 1997).

Since its initial validation, the BPFAS has been used in a variety of pediatric populations, including children with feeding problems (Dovey, Jordan, Aldridge, & Martin, 2013; Dovey & Martin, 2012; Golik et al., 2013), T1DM (Patton et al., 2006; Powers et al., 2002), CF (Crist et al., 1994; Mitchell, Powers, Byars, Dickstein, & Stark, 2004; Powers et al., 2002), obesity (Davis, Canter, Odar Stough, Dreyer Gillette, & Patton, 2014), and ASD (Martins, Young, & Robson, 2008). The BPFAS can discriminate between children referred to a clinic for feeding problems and non-clinic-referred children (Crist & Napier-Phillips, 2001). Moreover, all of the BPFAS subscales appear sensitive to decreasing problematic mealtime behavior following intervention (Davis, Sampilo, Gallagher, Landrum, & Malone, 2013; Dovey & Martin, 2012; Owen et al., 2012). Although, when used in a sample of rural children who are overweight and obese, an alternative five-factor solution was identified, suggesting that some items are not appropriate for this population (Davis et al., 2014).

The BPFAS has been identified as a valid and clinically useful measure of dietary adherence and problematic mealtime behaviors, in addition to identifying families with dysfunctional mealtime routines in need of behavioral interventions (Patton et al., 2006; Piazza-Waggoner, Modi, et al., 2008). Clinical cutoffs have been established for clinical and nonclinical samples, providing evidence that the BPFAS is sensitive in determining differences between the two samples. Because the BPFAS has been widely used and demonstrates clinical and research utility, it is classified as *well-established*.

Children's Eating Behavior Inventory

The Children's Eating Behavior Inventory (CEBI; Archer, Rosenbaum, & Streiner, 1991) is one of the original measures of child mealtime behavior. It was created to assess problems across a variety of medical populations and across age ranges in nonchronically ill populations. The CEBI has 40 items, which are used to calculate two scales, the Total Eating Problems and the Total Perceived Problems scores. Before the development of ASD-specific measures, the CEBI was used in several studies evaluating mealtime behavior and disruption in children with ASD (Laud, Girolami, Boscoe, & Gulotta, 2009; Schreck & Williams, 2006; Schreck, Williams, & Smith, 2004). For example, using the CEBI, Schreck et al. (2004) found that children with ASD have more needs during mealtime, such as specific utensils, and increased food refusal than typically developing children. They also found that children with ASD ate less food from each food group than typically developing children, despite similar food variety among the families. Laud et al. (2009) demonstrated sensitivity to change on the CEBI in children with ASD enrolled in an outpatient feeding program, with significant reductions in Total Eating Problems following discharge from the program. The CEBI has demonstrated adequate to good internal consistency and test–retest reliability (Archer et al., 1991). Because it has been published by several research teams in several

Table IV. Promising Measures

	Age range	Number of items	Factor analysis	Interrater reliability
Parent-/self-report measures				
Brief Assessment of Mealtime Behavior in Children	18 months–17 years	10	CFA Hospital feeding clinic w/ & w/o ASD .70–.79 EFA ASD w/ & w/o feeding problems .70–.79	
Child Eating Behavior Questionnaire	1–11 years	35	CFA CS .72–.91	
Child Feeding Assessment Questionnaire	1–11 years	Not given		
Child Feeding Questionnaire	≤7 years	31	CFA CS .37–.92	
Eating in the Absence of Hunger for Children and Adolescents	6–19 years	14	EFA Obesity .60–.86	
Eating in the Absence of Hunger—Parent	6–17 years	Not given		
Eating Behaviors Questionnaire	2–12 years	Not given		
Feeding Strategies Questionnaire	2–6 years	40	CFA Feeding .72–.86 CS .73–.88 EFA CS .70–.89	
Meals in Our Household	3–11 years	50	CFA ASD .63–.93 CS .39–.93	
Parent Mealtime Action Scale	2–17 years	31	CFA Feeding .16–.98 CS .49–.87	
Direct observation schedules				
ABC Mealtime Coding System	5–12 years			Asthma ICC .86–.98
Family Mealtime Q-Sort	5–12 years	54		Asthma ICC .32–.88
The Feeding Resistance Scale	6–32 months	20		Feeding ICC .82–.93

Note. CFA = confirmatory factor analysis; EFA = exploratory factor analysis; CS = community sample; ASD = autism spectrum disorder; values represent factor loadings.

peer-reviewed journals, the CEBI is identified as *approaching well-established*

Child Eating Behavior Questionnaire

The Child Eating Behavior Questionnaire (CEBQ; Wardle, Guthrie, Sandersen, & Rapoport, 2001) was originally developed in the United Kingdom for use in nonclinical samples of children 3–11 years old. However, the CEBQ has been used to assess mealtime behavior in several populations, including ASD, developmental disabilities, and feeding-clinic children (Hendy, Williams, Riegel, & Paul, 2010; Seiverling, Hendy, & Williams, 2011). The CEBQ yields eight dimensions of feeding behaviors (Food Responsiveness, Enjoyment of Food, Emotional Overeating, Desire to Drink, Satiety Responsiveness, Slowness in Eating, Emotional Underrating, and Fussiness).

Confirmatory factor analysis failed to replicate the original eight-factor structure of the CEBQ in a low-income, ethnically diverse sample (Sparks & Radnitz, 2012). Instead, exploratory factor analysis (EFA) yielded a three-factor version consisting of 15 questions. Given these conflicting factor structures, the CEBQ should be used cautiously in diverse samples. While there are inconsistencies among ethnically diverse populations, the CEBQ continually demonstrates good to excellent internal consistencies in children with ASD. It is considered *promising* because of its use by one research team in a single chronic illness population.

Child Feeding Assessment Questionnaire

The Child Feeding Assessment Questionnaire (CFAQ) was originally developed for use in typically developing children (Harris & Booth, 1992). The CFAQ consists of a background information section and three subscales: Mealtime Negativity, Food Refusal, and Food Fussiness. It has been used in children aged 12 months to 11 years across several chronic illness populations (phenylketonuria, growth disorders, and feeding problems). Overall, the CFAQ has appeared useful in describing mealtime behaviors in children with a chronic illness, but not to discriminate behaviors when compared with typically developing children (MacDonald, Harris, Rylance, Asplin, & Booth, 1997).

In conjunction with the BPFAS, the CFAQ has been sensitive to dietary changes as a result of intervention (Dovey & Martin, 2012). However, correlations between the BPFAS and CFAQ were not consistent, suggesting that further psychometric evaluation of the CFAQ is needed to assess its reliability and validity. Despite use of the CFAQ among several research teams, the lack of a validation study leads to its classification as *promising*.

Comprehensive Feeding Practices Questionnaire

The Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007) is a parent-report measure that is valid for use in children aged 4–8 years. Originally consisting of 12 child feeding scales when administered in a typically developing population, later factor analyses using a sample of treatment-seeking obese children demonstrated a better model fit using only a five-factor structure (Healthy Eating Guidance, Monitoring, Parent Pressure, Restriction and Child Control; Haszard, Williams, Dawson, Skidmore, & Taylor, 2013). Moreover, results from the obesity sample offered stronger psychometric properties and demonstrated correlations among subscales (i.e., Healthy Eating Guidance and Parent Pressure) with feeding practices and concern for child (Haszard et al., 2013). The CFPQ has demonstrated acceptable to excellent internal consistencies among the subscales when used in a pediatric obesity sample, but poorer consistencies when used with typically developing children. Therefore, it is categorized as *approaching well-established*. Future research should examine internal consistency of the CFPQ in additional chronic illness populations, given the discrepant findings between typically developing and obese samples.

Child Feeding Questionnaire

The Child Feeding Questionnaire (CFQ; Birch et al., 2001) consists of seven subscales (Responsibility for Feeding, Perceived Weight of Parent, Perceived Weight of Child, and Concern About Child Weight, Restriction, Pressure to Eat, and Monitoring of Eating) and has been used in children with chronic illness aged $\leq$7 years. Although the CFQ has not been shown to be sensitive to intervention changes, it may help to predict the occurrence of disordered eating after completion of an obesity intervention (Follansbee-Junger, Janicke, & Sallinen, 2010).

While the initial publication provided psychometrics for the CFQ in a largely White and middle- to upper middle-class sample, more recent studies report its psychometrics in diverse samples and determine that it may not be appropriate for minority samples, or that modified forms of the CFQ are needed for it to retain similar psychometrics (Anderson, Hughes, Fisher, & Nicklas, 2005; Boles et al., 2010). Because the range of internal consistencies from poor to good is dependent on the ethnic background of children, as well as its limited use in one chronic illness population, a classification of *promising* is warranted.

Eating in the Absence of Hunger for Children and Adolescents

Eating in the Absence of Hunger for Children and Adolescents (EAH-C; Tanofsky-Kraff et al., 2008) was designed for youth aged 6–19 years to assess the precipitants to eating when satiated. The EAH-C addresses two contextual types of eating behavior: Eating after satiation and eating in the absence of hunger. A principal components analysis confirmed a three-factor structure consisting of Negative Affect Eating, External Eating, and Fatigue/Boredom subscales, and each demonstrated good internal consistency. Obese children reported greater scores on the Negative Affect; however, no significant differences were observed between healthy-weight and obese children on the Fatigue/Boredom and External Eating subscales. In a study using the EAH-C, findings revealed that obese children reported higher scores of the Negative Affect subscale than healthy-weight children, but there were no differences in weight status for the remaining subscales (Fatigue/Boredom and External Eating; Tanofsky-Kraff et al., 2008). Another study, which did not assess for effects by child weight status, found a correlation between children who endorse symptoms of loss of control (LOC) of eating and higher scores on all three of the EAH-C subscales (Shomaker et al., 2010). Correlations were also found between the three EAH-C subscales and measures of internalizing symptoms and affective triggers, suggesting further exploration of discriminant validity may be needed (Tanofsky-Kraff et al., 2008). When compared with a laboratory-based assessment of EAH, child reports were not as accurate at determining eating in the absence of hunger (Shomaker et al., 2013). Owing to the inconsistent findings and emerging psychometric properties, the EAH-C is categorized as *promising*.

The Eating in the Absence of Hunger Questionnaire for Children and Adolescents Parent Report of Child (EAH-PC) is a supplementary measure, which was developed to assess parent's perceptions of their child eating past satiation. The EAH-PC consists of the same subscales. Among youth with overeating without LOC, subjective binge-eating, and objective binge-eating, parents reported higher Negative Affect and Fatigue/Boredom. Parent and youth reports have been shown to be somewhat discrepant (Shomaker et al., 2010), and findings are mixed about which reporter is the best informant of children's eating in the absence of hunger (Madowitz et al., 2014; Shomaker et al., 2013). An inverse relationship has been observed between parent report of EAH and an EAH paradigm, suggesting that laboratory assessments of eating in the absence of hunger provide more accurate information. To date, no known literature has reported on the psychometric properties of the EAH-PC measure, indicating that future research is needed and categorization of *promising* is warranted.

Eating Behaviors Questionnaire

The Eating Behaviors Questionnaire (EBQ; Martins et al., 2008) was designed specifically for use in children with ASD. Consisting of both parent and child subscales (Self-feeding Skills, Food Avoidance Behaviors, Ritualistic Feeding Behaviors, Child Control of His/Her Feeding Behaviors, and Parental Control of Child's Feeding Behaviors), past research has used the measure in children aged 2–12 years. Contrary to previous findings in ASD populations, using the EBQ, Martins et al. (2008) found only marginal differences in the types of feeding and eating difficulties experienced by children with ASD compared with their typically developing peers, and no differences were found between the two groups with respect to Ritualistic Feeding Behavior. Nevertheless, significant differences emerged among the groups when examining the occurrence of behavioral problems, as children with ASD who displayed eating and feeding difficulties experienced three times as many problem behaviors compared with their typically developing peers. The EBQ has only been used by one investigatory team, and there are no data available regarding its psychometric properties. Moreover, because there is limited research using the EBQ, its sensitivity to treatment remains unknown. Therefore, the EBQ is classified as *promising*. Future research should focus on greater scale development to strengthen and provide support for the measure's psychometric properties.

Feeding Strategies Questionnaire

Developed by a multidisciplinary team, the FSQ (Berlin et al., 2011) has been used in children aged 2–6 years from either a pediatric

feeding clinic or community sample. The FSQ contains six subscales (Mealtime Structure, Consistent Mealtime Routine, Child Control of Intake, Parent Control of Intake, Between Meal Grazing, and Encourages to Clean Plate), all of which have been found to correlate with one another, demonstrating construct validity. In addition, the scales have been found to associate with the AYCE-R, a previously established measure (Davies et al., 2007), suggesting concurrent validity. To date, only one known study and investigatory team has used the FSQ, thus it is categorized as *promising*.

Mealtime Behavior Questionnaire

Developed for use in young children (aged 24 months to 6 years) with feeding problems, the MBQ (Berlin et al., 2010) measures feeding problems using four subscales (Food Refusal/Avoidance, Food Manipulation, Mealtime Aggression/Distress, and Choking/Gagging/Vomiting) and a total score. Evidence of the measure's concurrent validity has been demonstrated by its association with the AYCE (Berlin et al., 2010; Hill et al., 2013). Moreover, it has demonstrated adequate to good internal consistency across subscales, although the Choking/Gagging/Vomiting subscale achieved only fair internal consistency in a community sample, suggesting that this subscale may be more relevant for children with chronic illness (Berlin et al., 2010). In addition to children with feeding problems, the MBQ has been used in a sample of children with single ventricle following staged palliation. Children with single ventricle deficits experienced more Food Manipulation, Mealtime Aggression, and Choking/Gagging/Vomiting (Hill et al., 2013), supporting previous beliefs that the Choking/Gagging/Vomiting subscale is more informative for children with chronic illness. Further support for the measure was demonstrated in a sample of tube-dependent children enrolled in a behavioral treatment program, as scores on the MBQ were significantly lowered posttreatment. As a result of its use by two independent research teams and reported psychometrics, the MBQ is classified as *well-established*. However, future research using the MBQ should examine psychometrics across multiple chronic illness populations.

Meals in Our Household

Meals in Our Household (MOH; Anderson, Must, Curtin, & Bandini, 2012) is a parent self-report questionnaire, divided into six domains (structure of family meals, problematic child mealtime behaviors, use of food as a reward, parental concern about child diet, spousal stress related to child's mealtime behavior, and influence of child's food preferences), which encompass family meal structure and environment, children's mealtime behavior and its impact on the family, parental concerns about children's diet, and use of food as a reward. MOH was originally designed for children aged 3–11 years with or without a developmental delay. The original scale reliability and validity statistics were conducted in two study populations consisting of parents of children with ASD and those who were typically developing; this design allowed for an original sample that represented a range of socioeconomic, race/ethnicity, and geographic categories. MOH demonstrated good internal consistency, excellent test–retest reliability, and good construct validity (as demonstrated by high correlations of domain scores between the two populations). Although MOH exhibits strong initial psychometric properties in children with ASD, the low internal consistencies obtained from the typically developing population question its consistency. Moreover, MOH has been used in only one pediatric population; therefore, MOH is classified as *promising*.

Parent Mealtime Action Scale

The Parent Mealtime Action Scale (PMAS; Hendy, Williams, Camise, Eckman, & Hedemann, 2009) has been used with children aged 2–17 years and applied to samples of children enrolled in feeding clinics with and without developmental disabilities and ASD. The PMAS generates scores for nine dimensions of child feeding practices: Set Snack Limits, Positive Persuasion, Daily Fruit and Vegetable Availability, Use of Rewards, Insistence on Eating, Snack Modeling, Fat Reduction, Many Food Choices, and Special Meals. It has been validated in a clinical sample of children with feeding problems, and findings suggest that it is a clinically useful screening measure of the impact of parent mealtime actions as they related to children's feeding problems (Williams, Hendy, Seiverling, & Hakan Can, 2011). Although attributed to the measurement of parental behavior rather than goals, Williams et al. (2011) reported questionable internal consistency, suggesting that scores should be interpreted with caution and further research of the psychometric properties is warranted. Owing to the range of psychometric results among several investigatory teams, the PMAS is categorized as *promising*.

Direct Observation Assessments

Direct observation assessments provide a coding scheme for use with a family meal in a naturalistic setting. Each assessment typically provides a structure for observing child problem eating behaviors. However, in addition to coding child eating behaviors, these assessments may code the environment of the meal, the behaviors of other individuals participating in the meal, and general affect regulation throughout the meal.

The ABC Mealtime Coding System

The ABC Mealtime Coding System (Fiese, Botti, & Greenberg, 2007) is a direct observation measure of videotaped mealtime behavior for children aged 5–12 years. The ABC Mealtime Coding System measures five dimensions of mealtime behavior, including Action-Oriented Behaviors, Behavior Control Behaviors, Mealtime-Oriented Communication, Positive Communication, and Critical Communication. Interrater reliability among published studies ranges from .86 to .98 (Fiese, Hammons, & Grigsby-Toussaint, 2012; Fiese, Winter, & Botti, 2011).

Among children with asthma, increased medical adherence and lower parent report of asthma symptoms were significantly correlated with positive communication. Asthma severity tended to worsen as families engaged in more behavior control behaviors (e.g., commands, redirection of mealtime activities). When exploring the role of weight status in mealtime behavior, the ABC Mealtime Coding System detected a significant difference in communication style, such that families with healthy-weight children with asthma engaged in a greater percentage of positive communication during the meal than families with an overweight/obese children with asthma (Fiese et al., 2012); however, no difference between groups was detected for percentage of time spent in activities or behavior control. The ABC Mealtime Coding System has demonstrated its utility in asthmatic populations and select subgroups, but future research is needed to evaluate the psychometric properties and

replicate the findings among other chronic illness populations. Thus, the ABC Mealtime Coding System has been categorized as *promising*.

Dyadic Interaction Nomenclature for Eating

The DINE (Powers et al., 2005; Stark et al., 1995, 1997) is a direct observation measure of videotaped home meals. The DINE consists of three categories: parent behaviors, child behaviors, and child eating behaviors. The various subdomains of the DINE are associated with several categories on the BPFAS (Piazza-Waggoner, Driscoll et al., 2008), demonstrating criterion validity. Although used in samples of children up to age 12 years, of particular interest and uniqueness is the use of the DINE in younger populations of children, typically 7 months to preschool age.

In children with T1DM, parent and child behaviors have been linked to children's adherence to dietary recommendations and overall glycemic control (Patton et al., 2006). However, when compared with healthy peers, there were few differences in parent behaviors and no differences in child behaviors in families of young children with T1DM (Patton et al., 2004). The DINE has also been applied to samples of children with CF, revealing a tendency among parents to issue more commands, signifying that children with CF require more mealtime management compared with their healthy peers (Powers et al., 2005). Across all populations (i.e., CF, T1DM, and healthy controls), children who took longer to eat tended to exhibit more disruptive eating behaviors.

The variety of populations, publications, and frequency of use suggests that the DINE is *well-established*. The DINE has been used by numerous research teams, and interrater reliability across all publications exceeded the kappa threshold of .60, which is considered acceptable.

Family Mealtime Q-Sort

The Family Mealtime Q-Sort (Kiser, Medoff, Nurse, Black, & Fiese, 2010) is an observational measure that has been used in children with asthma aged 5–12 years. The Q-sort scores gathered from videotaped meals are compared with the optimal Family Mealtime Interaction score to depict each family's mealtime practices. An EFA yielded a six-factor measure consisting of the following scales: Positive Tone, Meaningful Conversation, Clear Plan, Disruptions, Parenting Style, and Involvement (Kiser et al., 2010). Parenting Style and Involvement were not significantly correlated with the other scales or the Family Mealtime Interaction score. The remaining scales and the Family Mealtime Interaction score were significantly associated with the Mealtime Family Interaction Coding System (MICS; Dickstein, Hayden, Schiller, Scheifer, & San Antonio, 1994), with higher ratings on the Q-sort suggesting healthier functioning. Correlations among raters ranged from .32 to .88. To date, the psychometric properties of the Family Mealtime Q-Sort have been evaluated in one chronic illness population, leading it to be categorized as *promising*.

The Feeding Scale

The Feeding Scale (Chatoor et al., 1997) has been used to assess children aged 1–37 months with infantile anorexia, posttraumatic feeding disorder, failure to thrive, and various other feeding problems (Chatoor et al., 1997). A factor analysis yielded five subscales: Dyadic Reciprocity, Dyadic Conflict, Talk and Distraction, Struggle for Control, and Maternal Contingency. Results from a discriminant function analysis demonstrated the ability of the Feeding Scale to predict feeding disordered versus nonfeeding disordered group membership (Chatoor et al., 1997; Chatoor, Ganiban, Harrison, & Hirsch, 2001). More specifically, it is sensitive to different patterns of feeding behavior useful for differentiating between feeding disorder populations (Chatoor et al., 1997; Chatoor et al., 2001), although a nutritional assessment is still recommended for formally diagnosing a feeding (Chatoor, Hirsch, Ganiban, Persinger, & Hamburger, 1998). Interrater reliability ranged from .82 to .92, although it demonstrates some variability in test–retest reliability over a 2-week period (Chatoor et al., 1997). The Feeding Scale has been adapted for use in Italian populations to be more culturally sensitive to mother–child feeding interactions (Ammaniti, Ambruzzi, Lucarelli, Cimino, & D'Olimpio, 2004; Ammaniti, Lucarelli, Cimino, D'Olimpio, & Chatoor, 2010; Lucarelli, Cimino, D'Olimpio, & Ammaniti, 2013), although the psychometric properties have not been presented. The Feeding Scale is categorized as *well-established*, as it has been widely used in feeding disorder populations across numerous investigatory teams.

The Feeding Resistance Scale

The Feeding Resistance Scale (Chatoor et al., 2001) is an observational tool consisting of 20 statements, which provides a global index of feeding resistance, as well as information related to three subscales, Pre-oral Resistance I, Pre-oral Resistance II, and Intra-oral Resistance. Subscales demonstrated acceptable to good internal consistency, and interrater reliability, via intraclass correlations, ranged from .88 to .93. Similar to the Feeding Scale, patterns of feeding behavior emerged when comparing the Feeding Resistance Scale subscale scores across groups of feeding disorder populations (Chatoor et al., 2001; Lucarelli, Cimino, D'Olimpio, & Ammaniti, 2013). Currently, literature regarding the psychometric properties of the Feeding Resistance Scale is lacking, necessitating a categorization of *promising*.

Mealtime Interaction Coding System

The MICS (Dickstein et al., 1994; Hayden et al., 1998) is a multidimensional assessment adapted from the McMaster Structured Interview of Family Functioning, specifically designed for use in an unstructured, naturalistic mealtime situation. Dimensions are based on task accomplishment, communication, affect management, interpersonal involvement, behavior control, roles, and overall family function. To date, the MICS has been used in children aged 12 months to 13 years. Initially, the MICS was used to test the theory that mealtime routines in families of preschool children with CF differ from those of typically developing children (Janicke, Mitchell, & Stark, 2005; Spieth et al., 2001), and these findings spurred the development of a mealtime intervention for children with CF. Postintervention, Janicke et al. (2008) found that parents in the treatment group did not yield significant increases in interpersonal involvement and communication; however, affect management was improved. This suggests that the intervention helped to decrease families' expression of stress and frustration during mealtimes.

Additional pediatric populations where the MICS has been used include children with LOC, asthma (with and without symptoms of separation anxiety), T1DM, and those classified as overweight. An examination of children with and without LOC determined that

families of children with LOC experience more dysfunctional family functioning at mealtime, especially lacking in healthy communication and interpersonal involvement (Czaja et al., 2011). Jacobs and Fiese (2007) explored the role of family interactions in overweight, at-risk-for-overweight, and average-weight children with asthma and found that families of overweight children with asthma tended to have greater difficulties with meal management, establishing individual roles, and emotion dysregulation than the other families. A similar pattern was observed in families of children with asthma and symptoms of separation anxiety (Fiese, Winter, Wamboldt, Wamboldt, & Anbar, 2010). In an effort to understand differing parental practices among children, Moens, Braet, and Vandewalle (2013) adapted the MICS to examine discordant weight among siblings and found that more permissive mealtime behaviors were expressed by mothers when interacting with the heavier versus lighter child.

The MICS has been found to be strongly correlated with the McMaster Structured Interview of Family Functioning, demonstrating construct validity (Hayden et al., 1998) and interrater reliability among studies ranging from .62 to .97 for the various dimensions. The MICS has demonstrated its ability to detect varying parenting styles at mealtimes (Moens et al., 2013) and differentiate between types of family interactions between chronically ill and healthy children (Janicke et al., 2005; Piazza-Waggoner, Modi et al., 2008; Spieth et al., 2001). Thus, it is classified as *well-established*.

Mealtime Observation Schedule

The Mealtime Observation Schedule (MOS; Sanders & Le Gris, 1989; Sanders, Patel, Le Grice, & Shepherd, 1993) was originally developed for use in children with oppositionality, but was later repurposed for use in children with and without feeding disorders (Sanders et al., 1993; Turner, Sanders, & Wall, 1994). The MOS has been used to assess children aged 12 months to 6 years and consists of 17 separate categories for children and 14 categories for parents. Results from the MOS suggest that parents of children with feeding disorders tend to engage in more aversive feeding practices (e.g., more negative, coercive), which, in turn, increased children's noncompliance and food refusal. The MOS has also been used in children with CF and children with feeding disorders (Sanders et al., 1997), yielding reports that interactions between mothers and children with CF tend to be more aversive. Contrary to expectations, children with CF exhibited similar rates of disruptive behaviors as their nonclinic controls; yet, their parents rated their behavior as more problematic. To date, two known investigatory teams have used the MOS and mean interrater reliability across the two studies ranged from .71 to .99, which is deemed acceptable. Thus, it is classified as *well-established*.

Strengths

Of the 23 assessments included in the current review, 16 were parent-/self-report measures and 7 were direct observation measures. Three of the parent-report measures and four of the direct observation measures were classified as *well-established*, indicating a strong evidence base for some of the parent-report and the direct observation measures. Moreover, most of the parent-report measures have undergone factor analyses and demonstrate strong psychometric properties, which provide further support for their validity. From the literature, five measures (AYCE, BPFAS, CEBI, CFAQ, and DINE) appear sensitive to treatment changes. Of these, the AYCE-R has been used with the widest variety of populations, followed by the BPFAS, both of which are categorized as *well-established*. The FSQ and MBQ have demonstrated concurrent validity, suggesting that they also may be predictive of treatment outcomes.

An added strength of the validation process is the opportunity to explore the psychometric properties of measures across different populations. Based on these studies, it is evident that not all measures are appropriate for use across different populations. Overall, the majority of the measures have been used in children with feeding disorders and CF, followed by children with ASD.

Weaknesses and Future Directions

The purpose of this review was to provide researchers and clinicians with an EBA of mealtime behavior measures. Three measures met criteria for *approaching well-established* and 13 were categorized as *promising*, suggesting some clinical and research utility, but also areas of weakness that should be addressed in the future.

1. Eight measures (PMAS, MOH, EBQ, CFQ, CFPQ, CFAQ, CEBQ, and CEBI) lack concurrent, criterion, and construct validity. Thus, future research should focus on measuring this information to better guide researchers and clinicians in selecting the appropriate assessment tool.
2. Unfortunately, only a few measures (CEBQ, PMAS, The Feeding Scale, and CFQ) have been validated in pediatric, non-English-speaking families. Moreover, the factor structure of several measures (CFQ and CEBQ) did not hold when used in typically developing diverse populations. Failure to include a more diverse sample in measure development limits generalizability. Thus, future studies are needed for examining the performance of these measures across families from different cultures and ethnic groups. In the measures in which factor structures were examined in diverse samples, they were not as psychometrically sound. A significant amount of research needs to be conducted to investigate the validity/reliability among these groups. Only three of the measures reported diversity statistics in chronic illness populations, which suggests that this is a very underdeveloped area of the field.
3. Only one parent-report measure (BPFAS) has been used in conjunction with a validated direct observation measure. However, this would provide further validation of existing parent-report measures.
4. Only one measure has been developed for self-report (EAH-C). Although this may be inappropriate for some children because of their age or diagnosis, these data could be useful among children who are able to adequately rate their mealtime functioning. Their report may provide a unique perspective of family mealtimes and guide clinical interventions.
5. Only one known measure has taken into account the varying developmental levels of typically developing children (PMAS), despite known differences in children's mealtime behaviors across different age-groups. This is potentially concerning because some measures have been used in both young children and adolescents. Future research should focus on examining age and developmental differences to determine whether measures should be further modified based on child age.

Given the high prevalence of medical and psychosocial comorbidity that accompany many chronic illness populations, future

research should seek to explore the ways in which mealtime behaviors are impacted by these additional areas of concern.

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