Interview-based assessment of Avoidant/Restrictive Food Intake Disorder (ARFID): A pilot study evaluating an ARFID module for the Eating Disorder Examination

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Running head: EDE ARFID module 1.0

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Conflict of interest

The authors declare that they have no competing interests.

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Abstract

Objective: Although avoidant/restrictive food intake disorder (ARFID) has been included as a new diagnostic entity of childhood feeding and eating disorders, there is a lack of measures to reliably and validly assess ARFID. In addition, virtually nothing is known about clinical characteristics of ARFID in non-clinical samples.

Method: The present study presents the development and validation of an ARFID module for the child and parent version of the Eating Disorder Examination (EDE) in a non-clinical sample of $N = 39$ children between 8-13 years with underweight and/or restrictive eating behaviors. For evaluating the ARFID module's reliability, the convergence of diagnoses between two independent raters and between the child and parent module was determined. The module's validity was evaluated based on the full-length child version of the EDE, a 24h food record, parent-reported psychosocial functioning and self-reported quality of life, and objective anthropometric measures.

Results: In total, $n = 7$ children received an ARFID diagnosis. The ARFID module showed high interrater reliability, especially for the parent version, and high convergence between child and parent report. Evidence for the module's convergent, divergent, and discriminant validity was provided. Specifically, children with versus without ARFID reported significantly less macro- and micronutrient intake and were more likely to be underweight.

Discussion: This pilot study indicates the child and parent version of the EDE ARFID module to be promising for diagnosing ARFID in a structured way but still necessitates a validation in a larger clinical and community-based sample.

Keywords: interview, ARFID, eating disorder, feeding disorder, psychometric properties

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Introduction

The diagnostic category of eating disorders not otherwise specified within the Diagnostic and Statistical Manual for Mental Disorders (DSM; APA, 1987, 2000) was intended to present a residual category including those who have a clinically significant eating disorder, but do not meet the criteria for a specific eating disorder. However, the lack of positive diagnostic criteria resulted in a considerable variety of diagnoses, nosological challenges, and made evidence-based diagnostic and treatment options difficult to apply (Fairburn & Bohn, 2005; Thomas, Vartanian, & Brownell, 2009). Notably, this category accounted for more than half of the eating disorder diagnoses in childhood (Ornstein et al., 2013), adolescence, and young adulthood (Thomas et al., 2015). The recent inclusion of avoidant/restrictive food intake disorder (ARFID) within the feeding and eating disorder section of the fifth revision of the DSM (DSM-5; APA, 2013), though, was found to increase the diagnostic specificity of eating disorder classification in children (Ornstein et al., 2013). But research into specific clinical characteristics of ARFID, its epidemiology, and course is still in its early stages, not least due to the lack of a psychometrically sound instrument for assessing ARFID (Bryant-Waugh, 2013).

ARFID is characterized by the persistent and clinically significant failure to meet requirements for nutrition and/or energy intake in the absence of body image disturbances (APA, 2013). A DSM-5 ARFID diagnosis further requires the presence of significant weight loss or faltering growth, nutritional deficiencies (or related health impact), reliance on supplemental feeding, and/or psychosocial impairment. The food avoidance or restriction may be based on a lack of interest in eating, sensory characteristics of food, fear of choking, or emotional problems (APA, 2013; Norris et al., 2018). Children with ARFID seeking treatment at special eating disorder clinics were more likely to be male and younger than those with anorexia nervosa (AN), had a median body weight similar to (Nicely, Lane-Loney, Masciulli, Hollenbeak, & Ornstein, 2014) or slightly higher than those with AN (Fisher et al., 2014) and

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showed high comorbidity with anxiety disorders (Fisher et al., 2014; Nicely et al., 2014) and cognitive impairment (Nicely et al., 2014). In noneating disorder samples, ARFID and symptoms of ARFID were associated with male sex and underweight as well (Eddy et al., 2014; Kurz, Van Dyck, Dremmel, Munsch, & Hilbert, 2015; Schmidt, Vogel, Hiemisch, Kiess, & Hilbert, 2018).

Although the studies cited provided important information on the features of ARFID, they are limited by the lack of validated diagnostic instruments, with ARFID symptoms assessed retrospectively through medical chart reviews (e.g., Fisher et al., 2014; Nicely et al., 2014). Recently, the interview-based Eating Disorders Assessment for DSM-5 (EDA-5; Sysko et al., 2015) has been developed for practically assessing specified eating disorders including ARFID in adults. Although the interview is psychometrically sound for diagnosing AN and bulimia nervosa (BN), its reliability and validity for assessing ARFID is still unclear (Sysko et al., 2015). In addition, there is only a version for adults so far, although ARFID is likely to develop in early childhood (APA, 2013). A new, structured interview-based assessment for childhood eating disorders is the Pica, ARFID, and Rumination Disorder interview (PARDI; Bryant-Waugh et al., submitted) which can be used to make diagnoses of pica, ARFID, and rumination disorder (APA, 2013). In a recent pilot study, the validity and reliability of the self-report version of the PARDI was preliminarily evaluated in youths aged 10–22 years, but clinical measures for validation and convergence between self- and parent-report were not examined (Bryant-Waugh et al., 2018).

Developed in 1993, the Eating Disorder Examination (EDE; Fairburn, Cooper & O'Connor, 2014) is the most well-established structured eating disorder interview for research and clinical purposes with favorable psychometrics (Berg, Peterson, Frazier, & Crow, 2012). The EDE and its age-adapted version for children (ChEDE, Bryant-Waugh, Cooper, Taylor, & Lask, 1996) were designed to assess the specific eating disorder psychopathology and clinical eating disorders including AN and BN in individuals older than 7 years. With the

inclusion of binge-eating disorder (BED) as a research diagnosis into the DSM-IV-TR (APA, 2000), an additional BED module has been inserted into the EDE (Fairburn, Cooper, & O'Connor, 2008) and ChEDE (Hilbert et al., 2013). Now, in consideration of ARFID as a new clinical eating disorder diagnosis across the age range, we developed an ARFID module for the EDE, ChEDE, and the parent version of the EDE (Loeb, 2016).

The goal of this study was to evaluate an ARFID module for the ChEDE that can be used in combination or as a stand-alone diagnostic tool for the diagnosis of ARFID. Specifically, this study aimed to provide a first psychometric evaluation of the child and parent version of the EDE ARFID module using a population-based sample of children with underweight and/or restrictive eating behaviors. The module's interrater reliability, its convergence between the child and parent version as well as its convergent, divergent, and discriminant validity were determined using the full-length ChEDE, a 24h food record, well-established questionnaires on children's psychosocial functioning, quality of life, parental feeding practices, and objective anthropometric measures.

Method

Participants

The current sample was part of the ongoing LIFE Child study running at the 'Leipzig Research Centre for Civilization Diseases (LIFE)' (Poulain et al., 2017; Quante et al. 2012). One of this prospective longitudinal population study's aims is to identify risk factors of childhood obesity and associated mental disorders. Participants of the LIFE cohort are recruited via advertisement at different clinical institutions, public health centers, schools, by media, or by word of mouth. Since starting in 2011, more than 3000 study children (0-18 years) have been recruited, most of whom (99%) coming from the city or the close proximity of Leipzig. Since one goal of the study is to identify risk factors for obesity in children, there is a slight over-representation of children with obesity (Poulain et al., 2017) and under-

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representation of children with normal-weight compared to the German population (Brettschneider, Schienkiewitz, Schmidt, Ellert, & Kurth, 2017). However, the prevalence of underweight in the LIFE study is comparable to that of the German general population. The study was approved by the Ethics Committees of the Medical Faculty of the University of Leipzig, Germany (Reg. No. 264-10-19042010). Informed consent and assent were obtained from the children and at least one parent. Recruitment for the present study took place between February 2016 and February 2017.

Participants' eligibility was based on the following criteria: (a) child age between 8 and 13 years, (b) underweight defined as a standard deviation score (SDS) of the body mass index (BMI, kg/m^2) < -1.28 (Wabitsch & Kunze, 2014), and/or (c) presence of restrictive eating behaviors based on a mean score > 2 of the Eating Disorders in Youth-Questionnaire (EDY-Q; Van Dyck & Hilbert, 2016), a brief self-report questionnaire for assessing a range of avoidant and restrictive eating behaviors in children (Kurz et al., 2015; Kurz, Van Dyck, Dremmel, Munsch, & Hilbert, 2016). Eligible children and one parent were screened during a short telephone interview to validate the presence of avoidant/restrictive eating behaviors. Specifically, parents provided information on the child's age, height, weight, weight trajectory during the last 3 months, the presence of particular eating behaviors (e.g., selective eating), difficulties eating enough, and nutritional deficiency. Children were asked six items of the EDY-Q (five items on avoidant/restrictive eating behaviors and 1 item on body image misperception) in an orally adapted response format (dichotomized into yes vs. no). Children were classified into the avoidant/restrictive eating group if parents or children reported any ARFID-associated eating behavior and the absence of body image misperception. Of $n = 62$ children screened, $n = 25$ children and their parents reported avoidant or restrictive eating behaviors (avoidant/restrictive eating group) and were thus included. Sample characteristics are depicted in Table 1.

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In addition, a nonsymptomatic control group was recruited that was stratified to the avoidant/restrictive eating group based on age, sex, and BMI-SDS. Inclusion in the control group required child age between 8 and 13 years while restrictive eating behaviors were absent as determined via a mean score ≤ 2 of the EDY-Q (Van Dyck & Hilbert, 2016), which was validated via telephone screening using the items described above. Of the n = 37 eligible children, n = 14 children were stratified to the avoidant/restrictive eating group and were thus included in the control group.

Development of an ARFID module for the EDE

The development of the ARFID module version 1.0 was based on available literature on ARFID presentations (e.g., Bryant-Waugh, Markham, Kreipe, & Walsh, 2010), the DSM-5 criteria (APA, 2013), and clinical experience. The ARFID module was designed for use with both adults and children, in order to capture ARFID across the age range. Thus, three versions of the ARFID module 1.0 were developed: an adult version for assessing ARFID in youths > 14 years and adults (cf. EDE; Fairburn et al., 2014), a child version for children aged 8 to 14 years (cf. ChEDE, Bryant-Waugh et al., 1996), and a parent version (cf. EDE-Parent Version, P-EDE; Loeb, 2016). The ARFID module was designed to be inserted at the end of the (Ch)EDE, so that it can be used in addition to this interview, but could also be used stand-alone if needed. The duration of the module is about 20 minutes. In accordance with the BED module of the EDE, the ARFID module initially assesses the core feature of ARFID, i.e., the presence of avoidant/restrictive food intake during the past three months. Based on the evaluation of a representative eating day for each of the last three months, the interviewer decided whether there was inadequate food intake based on volume, variety, or both, and noted the number of days of inadequate food intake for each of the last three months. Days with inadequate food intake due to medical or mental illness, religion, or lack of food were not considered, unless the avoidance or restriction of food intake warranted independent

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clinical attention in the case of a concurrent medical or mental illness. Dependent on whether insufficient food intake was documented on more than half of the days for each of the last three months, subsequent questions address diagnostic items, for example, the presence of weight loss or faltering growth. The last section of the module included questions about the specific eating patterns leading to insufficient food intake, in order to evaluate the presence of specific ARFID presentations as described in the DSM-5. The following presentations were assessed: (1) apparent lack of interest in eating or food, describing children with low appetite, eating little and slowly, and going a long time without eating unless presented with favorite foods, (2) selective eating, characterizing children with high sensory sensitivities, aversions to specific tastes, smells, or textures, for example, and/or food neophobia, (3) fear of aversive consequences, describing children with predominant food- and eating-related anxieties due to conditioned negative responses associated with food intake following, or in anticipation of, an aversive experience, such as choking, and (4) food avoidance emotional disorder including children with more generalized emotional difficulties that do not meet diagnostic criteria for an anxiety, depressive, or bipolar disorder (APA, 2013). As described previously (Thomas et al., 2017), ARFID presentations are not mutually exclusive and were allowed to co-occur.

For the present study, only the child and parent version of the ARFID modules were evaluated. All interviews were randomly allocated to two interviewers and audiotaped for determining interrater reliability. Each interviewer administered both the ChEDE and the ARFID module per child. While all child interviews were completed in person, some parent interviews were conducted via telephone due to parents' limited availability on site. As a standard procedure, the ChEDE calendar was sent to the families prior to the appointment.

Measures for validation

Sociodemographic and anthropometric data. Children's age and sex were assessed via parent-report. Likewise, parents provided information about their highest educational and

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professional degree, current profession, and income which were used to calculate the family's socio-economic status (Lange et al., 2007) ranging from 3 to 21, with higher scores indicating higher socio-economic status. Children's height and weight were objectively measured by trained assessors and used to determine children's BMI-SDS.

Eating disorder psychopathology. The ChEDE full length form (Bryant-Waugh et al., 1996; Hilbert, 2016) was administered in-person and conducted by trained interviewers. In total, 22 items assess the level of eating disorder psychopathology during the last 28 days, including restraint, eating concern, weight concern, and shape concern. In addition, 13 diagnostic items allow for the diagnosis of AN, BN, or BED. The ChEDE has good psychometric properties including excellent interrater reliability, adequate test-retest reliability, good internal consistency, as well as high convergent and discriminant validity (Hilbert et al., 2013). For the present study, internal consistency for the weight and shape concern subscales was acceptable to good with Cronbach's alpha of .70 and .86. Due to low variances in the items from the restraint and eating concern subscales, Cronbach's alpha could not be calculated.

Food intake. At the beginning of the ARFID module, children and parents reported child food intake of a representative eating day in an interview format, which was used to determine main nutritional information (e.g., consumed daily energy in kcal) using EBISpro® (University of Hohenheim/Stuttgart, 2016), a research software tool for analyzing macro- and micronutrient information of food intake. To cover the broad age range, nutritional analyses were based on age- and sex-specific reference data (German Nutrition Society, 2015) and were presented as the percentage of recommended macro- and micronutrient intake.

General psychopathology and quality of life. The parent-report version of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) was used to assess child problem behaviors. The SDQ provides data on child emotion problems ($\alpha = .60$), conduct problems ($\alpha = .62$), peer problems ($\alpha = .70$), and hyperactivity ($\alpha = .87$), which are summed

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up to a total score (α = .68), as well as prosocial behavior (α = .68). Higher sum scores of the subscales, ranging from 0 to 10, and the total difficulties score, ranging from 10 to 40, indicate greater problem behaviors except for the prosocial behavior subscale. The child version of the KIDSCREEN (Ravens-Sieberer et al., 2005) assesses diverse areas of child quality of life, specifically psychological (α = .77) and physical well-being (α = .53), autonomy and parents (α = .47), peer and social support (α = .84), and school environment (α = .56). Higher subscale T-values indicate better quality of life.

Parental feeding practices. The level of parental restriction (α = .77), monitoring (α = .92), and pressure to eat (α = .83) were assessed using the Child Feeding Questionnaire (CFQ; Birch et al., 2001; Schmidt et al., 2017). Higher mean scores, ranging from 1 to 5, indicate greater use of these feeding practices.

Data Analytic Plan

The EDE ARFID module's interrater reliability between two independent raters for ARFID diagnostic items (nutritional deficiency, growth failure, supplemental feeding, and psychosocial impairment), ARFID diagnosis (yes, no), and the number of days with avoidant/restrictive food intake was determined using Cohen's κ and intra-class-correlation (ICC) coefficients in two-way mixed models with absolute agreement (Shrout & Fleiss, 1979) for categorical and continuous variables, respectively. The same analytic strategy was used for calculating the convergence between child and parent interviews. According to Landis and Koch (1977), κ can be interpreted as poor ($\kappa \leq 0.20$), fair ($0.20 < \kappa \leq 0.40$), moderate ($0.40 < \kappa \leq 0.60$), substantial ($0.60 < \kappa \leq 0.80$), or almost perfect ($\kappa > 0.80$). According to Portney and Watkins (2013), an ICC < 0.50 was considered as unsatisfactory, ICC < 0.75 as moderate to poor, and ICC ≥ 0.75 as high.

For determining the module's convergent and divergent validity, groups of children (ARFID diagnosis: yes vs. no) were compared in their typical energy intake and their levels of

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weight and shape concern (ChEDE), respectively. For evaluating the module's discriminant validity, groups of children (ARFID diagnosis: yes vs. no) were compared in sociodemographic (age, sex, Winkler index), anthropometric (raw and standardized body weight, height, and BMI), and clinical variables (SDQ, KIDSCREEN, CFQ). Due to small group sizes, Mann-Whitney *U* Tests were used to test for group differences. Effect sizes for between-group differences were estimated with Cohen's *d*, which can be interpreted as small ($d \geq 0.2$), medium ($d \geq 0.5$), or large ($d \geq 0.8$), respectively (Cohen, 1988). Negative *d* values indicated that children with ARFID scored lower on the respective measure than children without ARFID.

All statistical analyses were performed using IBM® SPSS Statistics® version 24.0 with a two-tailed $\alpha < .05$.

Results

ARFID diagnosis

Of the total sample ($N = 39$), $n = 9$ children, all of them belonging to the avoidant/restrictive eating group, reported an inappropriate volume or variety of food intake. In the control group, none of the children reported any avoidant/restrictive eating behaviors. In total, $n = 7$ children from the avoidant/restrictive eating group (28.0%) received an ARFID diagnosis, but none of the control group. The diagnosis was based on inadequate energy intake in $n = 2$ children, inadequate food variety in $n = 2$ children, and both inadequate energy intake and food variety in $n = 3$ children. Most children with an ARFID diagnosis were selective eaters ($n = 4$), some were characterized by a lack of interest in eating or food ($n = 2$), and $n = 1$ child met criteria for both selective eating and fear of aversive consequences. No eating disorder other than ARFID was determined during the interviews. A description of ARFID cases is depicted in Table S1.

Reliability

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Interrater reliability. The number of days with avoidant/restrictive food intake was significantly associated between the two raters for the child version, ICC = .746, $p < .001$, and for the parent version, ICC = .888, $p < .001$ (Table 2). The two raters showed substantial agreement regarding ARFID diagnosis, $\kappa = 0.62$ (92 % agreement), and substantial agreement in diagnostic items, $0.79 \leq \kappa \leq 1.00$ ($89 \leq$ % agreement ≤ 100), based on child report. For parent report, interrater-reliability was almost perfect for ARFID diagnosis, $\kappa = 0.92$ (97 % agreement), and substantial for diagnostic items, $0.66 \leq \kappa \leq 1.00$ ($92 \leq$ % agreement ≤ 100).

Convergence between child and parent version. The number of days with avoidant/restrictive food intake was highly associated between child- and parent-report for the last 28 days, ICC = .965, $p < .001$, as well as month 2 and 3, ICC = 0.960, $p < 0.001$. Both sources of interview data revealed substantial agreement in ARFID diagnosis, $\kappa = .80$, and substantial agreement in diagnostic items of ARFID, $0.66 \leq \kappa \leq 1.00$. Based on child-report, $n = 5$ children (12.8%) received an ARFID diagnosis, while this was true for $n = 7$ children (17.9%) based on parent-report. In the two cases where an ARFID diagnosis was made by parent-report only, children reported inadequate volume and/or variety of food intake as well, but did not report associated health impact necessary for an ARFID diagnosis, such as weight loss/reduced growth. For all further analyses, ARFID diagnoses based on parental data were used ($n = 7$).

Validity

Convergent validity. As shown in Table S2, children with versus without ARFID consumed significantly less total energy as well as less protein and fat with large effects based on child- ($d \geq -0.88$) and parent-report ($d \geq -1.16$). For carbohydrates, there were significant large-size group differences based on child-report, but not for parent-report. While large-size group differences were found for all micronutrient data based on child-report ($d \geq -0.81$) with children with versus without ARFID reporting reduced intake, a large-size group difference

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based on parent-report was only found for zinc intake (d = -0.81), while medium-size effects were found for calcium (d = -0.62) and phosphate intake (d = -0.54). Generally, there were significant correlations with large effect sizes between child- and parent-report for nutritional data, ranging from r = .62 for fat intake to r = .73 for protein intake (all ps < .001).

Divergent validity. Children with ARFID showed low mean scores in the weight concern and shape concern subscales of the ChEDE (Table 3). Although non-significant, the differences between ARFID and non-ARFID cases were of medium effect size (d = -0.54 and d = -0.61).

Discriminant validity. Children with versus without ARFID diagnosis did not significantly differ in any of the sociodemographic and anthropometric data except for child weight status showing that the majority of children with ARFID was underweight, while most children without ARFID were classified as being normal-weight. Although nonsignificant, medium-to-large effects were found for raw and standardized data of child body height and weight with children with ARFID showing much smaller values than children without ARFID ($d \geq$ -0.62 and $d \geq$ -0.57).

Concerning clinical variables, significant, large-sized group differences were found for SDQ prosocial behavior (d = -0.80), peer problems (d = 1.31), and total difficulties (d = 0.98). For child quality of life, significant, large-size effects were found for the KIDSCREEN domains autonomy and parents (d = -0.94) as well as peer and social support (d = -1.43). Children with versus without ARFID reported a lower quality of life. For child hyperactivity and conduct problems trend-wise significant, medium- to large-sized effects indicate that parents of children with versus without ARFID reported greater problem behaviors (d = 0.80 and d = 0.49). A nonsignificant, but medium-sized effect was found for the CFQ subscale pressure to eat in terms that parents of children with versus without ARFID reported greater use of pressuring their child to eat (d = 0.51). No other significant or large-size effects were found.

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Discussion

This study presented pilot data of a newly developed ARFID module for the child and parent version of the EDE. In a nonclinical sample of 8-13 year old children with underweight and/or restrictive eating behaviors, the EDE ARFID module showed high reliability, convergent, and divergent validity as well as the ability to discriminate children with versus without ARFID in anthropometric and clinical characteristics. The results indicate that the child and parent ARFID modules have promise for diagnosing ARFID in a reliable and valid way. In addition, this study's findings may add to the psychological characterization of ARFID in nonclinical settings, over and above the few studies in treatment-seeking samples with restrictive eating disorders (e.g., Fisher et al., 2014; Nicely et al., 2014; Norris et al., 2014).

Based on high convergence between two independent raters in ARFID diagnosis and diagnostic items, the module was found to provide reliable diagnostic information. Notably, the agreement between both raters was higher for the parent than the child version of the EDE ARFID module, which may be related to developmental differences among the sources of information. Specifically, children commonly have a lower verbal ability and lower ability for introspection than their parents, or may respond in a socially desirable way, resulting in more ambiguous diagnostic information for the rater. In addition, parents may be more likely to give an unambiguous assessment of a child's eating behavior than children themselves as they have a different perspective on what is normal through comparisons with other children of the same age.

In contrast to Mariano et al. (2013) who found poor to moderate agreement for the presence of behavioral features of eating disorders between the child and parent version of the EDE in a clinical sample of 8-18 year old children and adolescents, the present study revealed substantial convergence between child- and parent-report. Thus, the results were comparable

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to a study in 14-18 year old youths from the community demonstrating substantial agreement between child- and parent-report for a diagnosis of AN, but not BN (Cantwell, Lewinsohn, Rohde, & Seeley, 1997), which might mirror the observable nature of food avoidance or restriction and reduced weight status compared to other eating disorder behaviors occurring in secret, such as binge eating (Mariano et al., 2013). Importantly, in the present study, parental reports were very valuable for providing additional diagnostic information on the impact of avoidant and restrictive eating behaviors, specifically in younger children. For example, the diagnosis of ARFID in a 10-year old girl was based on her mother's report that the girl avoided situations in which it would be difficult for the daughter to find food she could eat, for instance at school trips, indicating an impairment in the girl's social life. Generally, it is recommended to use both the child and parent versions of the EDE ARFID module to identify clinically relevant avoidant/restrictive eating behaviors and associated features. This may be especially true for nonclinical samples with ARFID, as their clinical presentation might not be as severe and clear as found in treatment-seeking samples that are characterized, for example, by substantial nutritional deficiency and reliance on enteral feeding (e.g., Pennell, Couturier, Grant, & Johnson, 2016).

As the results on the ARFID module's convergent validity showed, children with ARFID consumed about 62-68% of the recommended daily energy intake based on parent- and child-report, respectively, thus reflecting the diagnosis' main definitional feature (APA, 2013). Mirroring these restrictions in food intake, children with versus without ARFID reported lower intakes of important micronutrients such as calcium or phosphate, which is in line with recent evidence on electrolyte abnormalities in adolescents with ARFID (Strandjord, Dieke, Richmond, & Rome, 2015) and may be related to a range of adverse physical symptoms (Brigham, Manzo, Eddy, & Thomas, 2018). Strikingly, child- and parent-reports on children's food intake were highly associated indicating that child-report of food intake may provide reliable nutritional information. This result goes in line with a study in 8-11 year

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old children demonstrating that child-report of child food intake was close to the true food intake as measured via doubly labeled water method and more exact than maternal and paternal reports of child food intake (Burrows et al., 2013). The majority of children were described as selective eaters due to a limited variety of food intake (71%), while only a minority were classified as limiting their food intake due to a lack of interest in eating (29%) or aversive events (14%). The present preponderance of subtypes which can be characterized as pathological picky eating or food neophobia may be related to the community-based recruitment (Kurz et al., 2015), while subtypes with eating- or food-specific anxiety are more likely to be found in clinical samples (e.g., Fisher et al., 2014; Norris et al., 2018).

As food avoidance and restriction in children with ARFID do not result from body image disturbances as characteristic of AN and BN (APA, 2013), low mean scores of the ChEDE weight concern and shape concern subscales support the module's divergent validity. These subscales' mean scores were descriptively lower compared to those of 9-13 year old children from the community (Colton, Olmsted, & Rodin, 2007). Based on objectively derived anthropometric data, we found large-sized differences between children with and without ARFID for children's height and weight indicating reduced growth in children with ARFID, thus validating its diagnostic criterion of faltering growth (APA, 2013). Similarly, most children with ARFID were classified as underweight which is in line with findings from clinical eating disorder samples (e.g., Nicely et al., 2014).

Consistently, children with versus without ARFID were characterized by significantly greater peer problems and reduced quality of life in the social and peer domain as previously identified in a clinical sample of children with ARFID (Nicely et al., 2014). In addition, children with versus without ARFID reported a significantly lower quality of parent-child relationship which might be related to actual stressful parent-child conflicts at mealtimes, similar to children with subclinical picky eating (Mascola, Bryson, & Agras, 2010). Regarding parental feeding practices, the study yielded a pattern of parental feeding that was

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to be expected. While parental monitoring and restriction were not specifically related to an ARFID diagnosis, parents of children with versus without ARFID reported greater pressure to eat which is similar to findings in underweight children (e.g., Shloim, Edelson, Martin, & Hetherington, 2015) and children with picky eating (Antoniou et al., 2016). Considering longitudinal evidence in children with underweight (Webber, Hill, Cooke, Carnell, & Wardle, 2010), which indicated a child-responsive model of parental feeding style, parental pressure to eat may be used in response to children's low weight status and parental concerns about their children's diet, although evidence is yet inconsistent in this respect (Galloway, Fiorito, Francis, & Birch, 2006; Van der Horst, 2012) and longitudinal studies in ARFID are needed to clarify this cross-sectional association.

Among the strengths of this pilot study is the consistency in format, style, and scoring between the ARFID modules and the well-established ChEDE. The ARFID module's detailed coding instructions are likely to increase interrater reliability for an ARFID diagnosis which has been challenging using more practice-oriented measures (EDA-5, Sysko et al., 2015). The interviews were administered and rated by two independent raters. Finally, the inclusion of an age-, sex-, and BMI-SDS matched control group ruled out systematic group effects due to these variables. Among the limitations, both the total sample and, due to recruiting a nonclinical sample of children, the number of children meeting ARFID was relatively small, thus reducing the study's ability to conduct analyses with sufficient power. In particular, the module's interrater reliability was determined using the total sample, thus, it remains to be evaluated whether the result on the interrater reliability can be replicated in a sample of children from the population with a sufficiently high number of children with and without ARFID to test disorder-specific psychometric characteristics, along with replicating the results on the module's validity in a larger sample. As the sample was recruited from the population, generalization of the present results to the ARFID module's psychometric properties in clinical samples of children with a restrictive eating disorder is difficult. As none

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of the families with a child with ARFID sought actual treatment for the eating disturbances, it is plausible to suggest that the clinical severity of ARFID was relatively low in the present sample. For clinical purposes, it would be particularly important to provide evidence for the module's ability to discriminate between children with AN and ARFID. Concerning the measure of children's food intake, a 24h dietary recall is generally prioritized over food frequency questionnaires as they provide more accurate measures of food intake (Freedman et al., 2014); however, a prospective, random sample of multiple 24h dietary recalls from the child and parent in combination with blood samples would reveal more valid information on children's intake of macro- and micronutrients. Finally, the present sample included children between 8 and 13 years only, as this age range allows comparisons between child and parent report, although ARFID is a lifespan diagnosis. Currently, the ARFID modules for use with adults and parents of children 0-7 years are subject to validation.

The development of a reliable and valid assessment of ARFID is a prerequisite of utmost importance for providing an in-depth clinical characterization, the identification of targets for early intervention, and for monitoring the temporal course of ARFID. Clinically, the study provided initial evidence for a psychometrically sound instrument for diagnosing ARFID in research and practice. Based on this study's data and expert review, a refined ARFID module 2.0 is currently validated in a larger clinical sample. The revised module includes all parts of the first module and additional questions on behavioral indicators (for example, specific reactions to foods the child does not like), which are, however, not necessary to make a diagnosis of ARFID, and two additional ARFID presentations, in order to help realize the heterogeneity of ARFID profiles, especially in clinical samples. As children with ARFID are at risk for medical problems, such as gastrointestinal complaints (Fisher et al., 2014), they are likely to present at paediatricians and other medical specialists. However, as ARFID is a new and psychiatric diagnosis, it is assumed that ARFID is still a largely unknown phenomenon for many clinicians. Together with informing clinicians about ARFID,

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the semi-structured EDE ARFID module has the potential to detect clinically relevant symptoms of ARFID and, thus, to devise appropriate treatment options.

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Table 1. Sociodemographic and anthropometric characteristics of the total sample, separately presented for the initial ARFID symptom and control group

	Avoidant/restrictive eating group (n = 25)	Control group (n = 14)	U	p
Sociodemographics				
Age, years	10.74 (1.60)	10.90 (1.61)	167.50	.826
Sex, female (n, %)	9 (36.0)	7 (50.0)	χ^2 (1) = 0.727	.503
Winkler index	13.40 (3.44)	13.79 (2.90)	71.00	.995
Anthropometrics				
Height SDS	-0.19 (1.07)	0.25 (1.11)	131.00	.198
Weight SDS	-0.98 (1.04)	-0.61 (0.90)	132.00	.208
BMI SDS	-0.98 (0.97)	-0.70 (0.99)	143.00	.349
Weight status			χ^2 (2) = 1.078	.583
Severe underweight (n, %)	4 (16.0)	2 (14.3)		
Underweight (n, %)	9 (36.0)	3 (21.4)		
Normal-weight (n, %)	12 (48.0)	9 (64.3)		

Note. ARFID avoidant/restrictive food intake disorder; BMI body mass index (kg/m²); SDS standard deviation score; Children's weight status was determined based on age- and sex-

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specific reference data from Germany (Wabitsch & Kunze, 2015). Mann-Whitney-U and Chi square tests were performed to test for group differences in metrical and categorical variables.

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Table 2. Interrater reliability of the ARFID module for the child and parent version of the Eating Disorder Examination

	Child report (n = 39)	Parent report (n = 39)
Food and nutritional intake	ICC	ICC
Days with restrictive eating behaviors, month 1	.746	.888
Days with restrictive eating behaviors, month 2	.746	.889
Days with restrictive eating behaviors, month 3	.746	.889
Diagnostic items	κ	κ
Weight loss/reduced growth	.789	.842
Nutritional deficiency	1.00	1.00
Enteral/supplemental feeding	1.00	1.00
Psychosocial impairment	1.00	.655
ARFID presentations		
Lack of interest	.655	.638
Selective eater	.865	.829
Food- or eating-related anxiety	1.00	1.00
Emotional problems	1.00	1.00
ARFID diagnosis	.623	.917

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Note. ARFID avoidant/restrictive food intake disorder. Intra-class-correlation (ICC) coefficient was used for continuous variables, while Cohen's kappa was used for categorical variables. All *p*s < .001.

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Table 3. Sociodemographic, anthropometric, and clinical characteristics of children as a function of avoidant/restrictive food intake disorder (ARFID)

	ARFID (n = 7)	No ARFID (n = 32)	U	p	d
Sociodemographics	M (SD)	M (SD)			
Age, years	10.44 (1.60)	10.87 (1.60)	100.00	.660	-0.27
Sex, female (n, %)	3 (42.9)	13 (40.6)	χ^2 (1) = 0.012	.913	Φ = .02
Winkler index	12.78 (2.50)	13.78 (3.42)	47.00	.524	-0.30
Anthropometrics					
Height, cm	139.44 (12.11)	147.33 (12.87)	76.00	.188	-0.62
Height SDS	-0.66 (1.10)	0.11 (1.06)	68.00	.107	-0.73
Weight, kg	30.13 (7.69)	35.76 (10.18)	76.00	.188	-0.57
Weight SDS	-1.36 (0.99)	-0.73 (0.98)	68.50	.111	-0.64
BMI SDS	-1.13 (0.86)	-0.83 (1.00)	93.00	.507	-0.31
Weight status (n, %)			χ^2 (2) = 6.908	.032	Φ = .42
Severe underweight	0 (0.0)	6 (18.8)			
Underweight	5 (71.4)	7 (21.9)			
Normal-weight	2 (28.6)	19 (59.4)			
Eating disorder psychopathology (ChEDE)					

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	ARFID (n = 7)	No ARFID (n = 32)	U	p	d
Weight concern	0.29 (0.25)	0.58 (0.58)	32.50	.887	-0.54
Shape concern	0.16 (0.17)	0.54 (0.68)	31.50	.819	-0.61
Quality of life (KIDSCREEN)					
Physical well-being	47.39 (3.23)	49.89 (5.87)	62.00	.265	-0.45
Psychological well-being	39.72 (3.47)	37.92 (2.34)	59.50	.220	0.71
Autonomy and parents	46.27 (5.58)	52.32 (6.56)	41.50	.045	-0.94
Peers and social support	40.44 (14.95)	54.03 (8.19)	30.50	.012	-1.41
School environment	55.24 (9.02)	56.67 (7.79)	76.00	.626	-0.18
Parent-report					
General psychopathology (SDQ)					
Prosocial behavior	6.86 (1.77)	8.31 (1.55)	58.50	.046	-0.80
Hyperactivity	5.14 (2.85)	3.09 (2.52)	64.00	.075	0.80
Emotional problems	2.57 (1.81)	2.09 (1.94)	91.50	.445	0.25
Conduct problems	2.72 (1.25)	1.84 (1.87)	64.50	.076	0.49
Peer problems	3.57 (2.44)	1.47 (1.39)	53.50	.028	1.31

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	ARFID (n = 7)	No ARFID (n = 32)	U	p	d
Total score	14.00 (3.79)	8.5 (5.88)	46.50	.016	0.98
Parental feeding practices (CFQ)					
Pressure to eat	2.79 (1.04)	2.23 (1.11)	85.00	.241	0.51
Monitoring	3.29 (1.68)	3.19 (1.14)	97.50	.769	0.08
Restriction	2.79 (1.61)	2.38 (0.95)	85.00	.458	0.38

Note. ARFID avoidant/restrictive food intake disorder; BMI body mass index (kg/m²); ChEDE Eating Disorder Examination adapted for children; CFQ Child Feeding Questionnaire; SDQ Strengths and Difficulties Questionnaire; SDS standard deviation score. For effect size *d*, negative values indicate that children with ARFID scored lower on the respective measure than children without ARFID.

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Supplemental Table S1. Case descriptions of children with an ARFID diagnosis

Age (y)	Sex	Height (cm)	Weight (kg)	BMI-SDS	ARFID diagnosis	ARFID subtype	Description of food intake	Birth week	Birth height (cm)	Birth weight (kg)	Months breast fed	Comment by parents
11	f	151	33	-1.74	parent, child	selective	avoids meat, fish, milk, some vegetables	39	51	3855	12	celiac disease (diagnosed at 3 months of age)
12	m	143	31	-1.71	parent, child	disinterest	forgets to eat, eats very slowly, only small amounts eaten	38	47	2140	0	after birth stomach tube for 2 months, then bottle-feeding (100ml in 1.5h)
9	m	129	24	-1.30	parent	disinterest	forgets to eat, only small amounts eaten, reminded and encouraged to eat and drink	40	55	4230	4	

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Age (y)	Sex	Height (cm)	Weight (kg)	BMI-SDS	ARFID diagnosis	ARFID subtype	Description of food intake	Birth week	Birth height (cm)	Birth weight (kg)	Months breast fed	Comment by parents
10	m	133	26	-1.29	parent, child	selective	avoids vegetables with few exceptions, cheese, very sensitive to smell, only small amounts eaten, full quickly	39	47	3260	8	
10	m	151	34	-1.18	parent, child	selective	avoids dairy products except cocoa, egg yolk, meat with two exceptions, fish, sauces, creamy foods	40	57	4254	6	

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Age (y)	Sex	Height (cm)	Weight (kg)	BMI-SDS	ARFID diagnosis	ARFID subtype	Description of food intake	Birth week	Birth height (cm)	Birth weight (kg)	Months breast fed	Comment by parents
8	f	121	20	-1.44	parent, child	selective	avoids meat, sausages except mortadella, egg yolk, cheese except cheese cracker	41	48	2990	12	by the age of 2.5 years bottle-feeding, eats sweet meals predominately, difficulty to chew meat
10	f	149	43	0.77	parent	selective, fear of aversive consequences	avoids potatoes, boiled vegetables, fish, cheese and butter on bread, sauces, egg yolk, some kind of sausages	39	52	4165	4	eating problems since birth, by the age of 8 years enuresis without physical reason, psychosocial impairment

Note. ARFID avoidant/restrictive food intake disorder; BMI-SDS body mass index-standard deviation score.

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ARFID diagnosis refers to the source of information; the diagnosis of ARFID was based on child- and/or parent-report; ARFID subtype refers to the specific presentation of ARFID; Description of food intake refers to the characterization of food intake and specific foods that are avoided or restricted.

Supplemental Table S2. Macro- and micronutrient intake based on child and parent food records as a function of avoidant/restrictive food intake disorder (ARFID)

	ARFID (n = 7)	No ARFID (n = 31)	U	p	d
Child module	M (SD)	M (SD)			
Food intake, total energy (%)	67.79 (11.53)	89.43 (17.53)	31.50	.003	-0.88
Protein (%)	78.04 (20.18)	112.41 (26.46)	28.00	.002	-1.35
Fat (%)	85.83 (29.05)	115.71 (33.68)	47.00	.017	-0.91
Carbohydrates (%)	55.70 (10.60)	70.40 (16.13)	49.00	.021	-0.96
Calcium (%)	43.26 (26.62)	60.68 (20.41)	59.00	.052	-0.81
Magnesium (%)	64.49 (24.69)	85.96 (24.40)	44.00	.013	-0.88
Phosphate (%)	62.41 (28.72)	94.07 (26.89)	29.00	.002	-1.16
Iron (%)	45.06 (10.84)	66.42 (20.96)	39.00	.008	-1.09
Zinc (%)	82.34 (24.32)	119.24 (34.76)	41.00	.009	-1.11
Parent module					
Food intake, total energy (%)	62.29 (12.85)	87.29 (20.85)	27.50	.002	-1.27
Protein (%)	81.73 (32.49)	110.84 (23.26)	42.00	.012	-1.16
Fat (%)	56.89 (21.39)	111.97 (33.97)	18.00	.001	-1.71
Carbohydrates (%)	60.36 (16.67)	68.75 (19.49)	93.00	.559	-0.44

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Calcium (%)	45.36 (20.08)	59.42 (23.36)	70.00	.147	-0.62
Magnesium (%)	102.03 (87.12)	91.48 (23.50)	82.00	.318	0.25
Phosphate (%)	76.10 (30.28)	90.66 (26.25)	73.00	.181	-0.54
Iron (%)	66.66 (55.74)	66.43 (18.57)	71.00	.158	0.01
Zinc (%)	89.87 (42.05)	123.16 (34.23)	54.50	.040	-0.93

Note. The percentage of the recommended macro- and micronutrient intake based on child age and sex reference values is presented.

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