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Prevalence and Correlates of Psychiatric Comorbidities in Children and Adolescents with Full and Subthreshold Avoidant/ Restrictive Food Intake Disorder

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Abstract

Objective: We aimed to characterize the current and lifetime prevalence of comorbid psychiatric diagnoses and suicidality in treatment- and non-treatment seeking individuals with full and subthreshold avoidant/restrictive food intake disorder (ARFID). We also sought to examine unique associations between the three *DSM-5* ARFID profiles (i.e., sensory sensitivity, fear of aversive consequences, and lack of interest in food or eating) and specific categories of psychiatric diagnoses and suicidality.

Method: We conducted structured clinical interviews with 74 children and adolescents with full or subthreshold ARFID to assess the presence of comorbid psychiatric diagnoses, suicidality, and the severity of each of the three ARFID profiles.

Results: Nearly half of the sample (45%) met criteria for a current comorbid psychiatric diagnosis, and over half (53%) met criteria for a lifetime comorbid diagnosis. Eight percent endorsed current suicidality and 14% endorsed lifetime suicidality. Severity in the sensory sensitivity profile was uniquely associated with greater odds of comorbid disorders in the neurodevelopmental, disruptive, and conduct disorders category; the anxiety, obsessive-

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Data Availability Statement: All data will be made publicly available through the National Institute of Mental Health National Database for Autism Research at the conclusion of the study.

compulsive, and trauma-related disorders category; and the depressive and bipolar-related disorders category. Severity in the fear of aversive consequences profile was associated with greater odds of disorders in the anxiety, obsessive-compulsive, and trauma-related disorders category.

Discussion: Our findings underscore the severity of psychopathology among individuals with ARFID and related presentations, and also highlight the potential that shared psychopathology between specific ARFID profiles and other psychiatric disorders represent transdiagnostic constructs (e.g., avoidant behavior) that may be relevant treatment targets.

Keywords

Avoidant/restrictive food intake disorder; ARFID; anxiety disorders; suicidality; comorbidity; diagnosis; structured interview

Avoidant/restrictive food intake disorder (ARFID) was introduced as a new feeding and eating disorder in *DSM-5* (APA, 2013). ARFID is characterized by avoidant or restrictive eating resulting in one (or more) of the following: significant weight loss or failure to achieve expected weight gain, nutritional deficiency, dependence on enteral feeding or oral nutritional supplements, and interference with psychosocial functioning. *DSM-5* describes three core ARFID presentations: avoidance based on the sensory characteristics of food, fear of aversive consequences associated with food intake, and lack of interest in food or eating (APA, 2013). The sensory sensitivity profile is characterized by food avoidance due to sensory properties of food (e.g., texture, taste). Individuals with the fear of aversive consequences profile exhibit food avoidance or restriction usually following a traumatic event related to eating (e.g., choking, vomiting). Finally, those presenting with the lack of interest profile typically endorse a lack of hunger or premature fullness, leading them to forget to eat or consume small volumes of food.

Few studies have examined the prevalence of co-occurring psychiatric disorders in ARFID. Exploring psychiatric comorbidities is important as it may highlight transdiagnostic constructs that place individuals at risk for developing ARFID or shared underlying mechanisms that could be targeted in treatment. It may also shed light on auxiliary treatments (e.g., psychopharmacological approaches) that could be helpful in treating individuals with ARFID. To date, the fstudies that have evaluated psychiatric comorbidity in ARFID among treatment-seeking samples suggest that the overall prevalence of co-occurring psychiatric disorders is high—ranging from 57% at a tertiary care pediatric hospital (Cooney, Lieberman, Guimond, & Katzman, 2018) to 95% at a day hospitalization program (Bryson, Scipioni, & Ornstein, 2017). In one study, 10% of patients with ARFID met criteria for more than one additional psychiatric disorder (Lieberman, Houser, Voyer, Grady, & Katzman, 2019), while in another study the figure was 25% (Cooney et al., 2018). Anxiety disorders have represented the most common comorbidity, with frequencies ranging from 36% (Cooney et al., 2018) to 72% (Nicely, Lane-Loney, Masciulli, Hollenbeak, & Ornstein, 2014). Of the anxiety disorders, generalized anxiety disorder has been the most commonly reported (Bryson et al., 2017; Fisher et al., 2014; Norris et al., 2014). Mood disorders appear to be the next most common, affecting 17% (Duncombe Lowe et al., 2019) to 33% (Nicely et al., 2014) of individuals with ARFID. Despite evidence that suicidality is

common among individuals with other eating disorders (Franko et al., 2004; Wang et al., submitted), only one study (Duncombe Lowe et al., 2091) to date has assessed suicidality among individuals with ARFID and did not report the overall prevalence in the sample. Prevalence of neurodevelopmental disorders was 10% in one study (Lieberman et al., 2019). Specifically, co-occurring rates of attention deficit/hyperactivity disorder (ADHD) have ranged from 4% (Nicely et al., 2014) to 26% (Duncombe Lowe et al., 2019) and co-occurring rates of autism spectrum disorder (ASD) have ranged from 3% (Lieberman et al., 2019) to 13% (Nicely et al., 2014).

Given the nascent literature on ARFID, the handful of studies that have examined co-occurring psychiatric disorders have been limited by small sample sizes, retrospective designs, a lack of structured interviews, a lack of differentiation between current and lifetime disorders, and reliance on treatment-seeking samples. Small sample sizes may have led to unreliable prevalence estimates of psychiatric diagnoses among individuals with ARFID. Further, with the exception of a few studies that conducted a real-time eating disorder diagnostic evaluation using *DSM*-5 criteria (Cooney et al., 2018; Duncombe Lowe et al., 2019; Lieberman et al., 2019) and another study that used an unstructured clinical interview (Reilly, Brown, Gray, Kay, & Menzel, 2019), the majority of studies have utilized chart reviews to retrospectively confer ARFID diagnoses. Considering that the first structured clinical interview to assess ARFID across the lifespan—the Pica, ARFID, and Rumination Disorder Interview (PARDI; Bryant-Waugh et al., 2019)—was not published until recently, the studies to date reporting psychiatric comorbidities in ARFID have been hindered by the lack of empirically validated assessments, which may have impacted diagnostic validity and reliability. Additionally, the studies to date have all used treatment-seeking samples, which may overestimate psychiatric comorbidity in comparison to community samples due to Berkson's (1946) bias. Moreover, no prior studies have differentiated between current versus lifetime comorbid diagnoses which is important for the etiological conceptualization of ARFID and for treatment planning.

Lastly, few studies have reported on whether or how psychiatric comorbidities may differ across the three core ARFID presentations described in *DSM-5*. Those that have (Norris et al., 2018; Reilly et al., 2019; Zickgraf, Lane-Loney, Essayli, & Ornsein, 2019a) have conceptualized the presentations as mutually exclusive categories, despite growing evidence that ARFID profiles may overlap (Bryant-Waugh et al., 2019). Conversely, our team recently proposed a conceptual three-dimensional neurobiological model of ARFID (consistent with the National Institute of Mental Health's Research Domain Criteria [RDoC] approach) wherein the three core presentations (i.e., sensory sensitivity, fear of aversive consequences, and lack of interest) occur along a continuum of severity and are not mutually exclusive (Thomas et al., 2017). To date, no research has sought to characterize the likelihood of psychiatric comorbidities across these three profiles using a dimensional model. This research is warranted as the three ARFID profiles share obvious similarities with other *DSM-5* diagnoses. Namely, the sensory sensitivity profile shares similarities with ASD, the fear of aversive consequences profile shares similarities with anxiety disorders, and the lack of interest profile shares similarities with major depressive disorder.

Similar to the sensory sensitivity profile of ARFID, selective eating (e.g., unwillingness to try new foods, avoiding certain food groups) is common among children with ASD (Williams, Dalrymple, & Neal, 2000; Williams, Gibbons, & Schreck, 2005; Nadon et al., 2011) and may be related to sensory processing deficits in the areas of taste or smell (Tomchek & Dunn, 2007; Wiggins, Robins, Bakemann, & Adamson, 2009). Reilly and colleagues (2019) reported that the prevalence of ASD in individuals with the "selective eating" presentation of ARFID was approximately 5%. In addition, similar to the fear of aversive consequences profile of ARFID, those with anxiety disorders may display heightened distress in the presence of anxiety-provoking or feared stimuli, typically resulting in avoidance. Indeed, Norris et al. (2018) found that individuals with the ARFID "aversive" profile had a 70% prevalence of anxiety disorders, and Zickgraf and colleagues (2019a) found that 77% of those exhibiting the fear profile had a comorbid anxiety disorder. Finally, lack of appetite is common in major depressive disorder (MDD) (Beck, 1967; Paykel, 1977), and may be due to decreases in experiences of pleasure (MacLeod & Salaminiou, 2011) or reward (McFarland & Klein, 2009) associated with food consumption. Interestingly, while previous literature has examined the prevalence of MDD and mood disorders in the ARFID lack of interest profile (e.g., Zickgraf, Murray, Kratz, & Franklin, 2019b), no research has examined whether a major depressive disorder diagnosis is more likely in this presentation. Furthermore, no research to date has used a dimensional model to investigate the relationship between ASD and the ARFID sensory sensitivity profile; anxiety disorders and the fear of aversive consequences profile; and MDD and the lack of interest profile. Examining these profiles dimensionally may provide greater power to detect associations between the three ARFID profiles and certain *DSM-5* diagnoses.

To that end, the current study aimed to characterize the prevalence and correlates of current and lifetime comorbid psychiatric diagnoses and suicidality in a sample of treatment- and non-treatment seeking children and adolescents with full and subthreshold ARFID. For our first aim, consistent with prior studies, we hypothesized that the majority of individuals with ARFID would meet criteria for at least one lifetime psychiatric comorbidity, and that anxiety disorders would be the most common co-occurring psychiatric diagnosis. For our second aim, we examined whether the severity of the three ARFID profiles would have unique associations with specific categories of psychiatric diagnoses or suicidality. First, we predicted that severity in the sensory sensitivity profile would be associated with higher odds of comorbid neurodevelopmental, disruptive, and conduct disorders. Second, we hypothesized that severity in the fear of aversive consequences profile would be associated with higher odds of comorbid anxiety, obsessive-compulsive, and trauma-related disorders. Third, we hypothesized that severity in the lack of interest profile would be associated with higher odds of comorbid depressive and bipolar-related disorders. We had no specific hypotheses concerning suicidality.

Method

Participants

Participants were 74 males and females, ages 9-22 years, recruited as part of an ongoing multidisciplinary study of the neurobiology of ARFID (National Institute of Mental Health

R01MH108595). Of these 74 participants, we had missing PARDI data on 2 participants for whom we were unable to characterize ARFID profiles, resulting in a total sample of 74 participants for our first aim and 72 participants for our second aim. For inclusion in the current study, participants had to either meet criteria for ARFID on the Eating Disorder Assessment for *DSM-5* (EDA-5; Sysko et al., 2015), or exhibit significant symptoms of avoidant/restrictive eating on questions keyed to *DSM-5* criteria for ARFID that we added to the Kiddie Schedule for Affective Disorders and Schizophrenia for School Age Children-Present and Lifetime Version 2013 Working Draft (KSADS-PL; Kaufman et al., 2013). Exclusion criteria were as follows: (a) any current feeding or eating disorder other than ARFID (determined by EDA-5), as *DSM-5* prohibits ARFID from being diagnosed concurrently with other eating disorders; (b) any current clinically significant disordered eating as evidenced by an Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn and Beglin, 2008) global score > 4.0, or self-reported self-induced vomiting, laxatives, diuretics, fasting, or compensatory exercise on the EDE-Q in the past 28 days; (c) current active suicidal ideation with plan or intent (though current passive suicidal ideation and past history of active suicidality were both allowed); (d) substance or alcohol use disorders that were active within the past month (determined by KSADS-PL); (e) current or lifetime psychosis (determined by KSADS-PL); and (f) medical history of intellectual disability (IQ < 70). Due to the multidisciplinary nature of the study, additional exclusion criteria pertaining to functional magnetic resonance imaging (fMRI) and neuroendocrine assessments were as follows: (a) hematocrit < 30%; (b) pregnant, breastfeeding, or use of hormones within eight weeks of the baseline visit; (c) contraindications to fMRI (e.g., severe concussion history, inability to tolerate); and (e) gastrointestinal tract surgery. Table 1 provides information on demographic and clinical characteristics of the sample, including age, body mass index (BMI), and percentage of 50^{th} centile BMI for sex and age (based on the 2000 Centers for Disease Control and Prevention growth charts; Kuczmarski et al., 2002).

Procedure

We obtained written informed consent from participants 18 years old and older. For participants ages 9 to 17 years, we obtained written informed consent from a parent or guardian, and participant assent. Following informed consent, participants completed an initial screening visit to determine study eligibility. The screening visit included the KSADS-PL, EDA-5, and EDE-Q. Participants then returned within a mean of 46.3 (SD = 42.1) days for a baseline visit. Study staff triply measured participants' height and weight using a stadiometer and calibrated scale and reported the average of these measurements. For both measurements, participants were wearing socks and gowns. Participants also completed the PARDI and neurobiological measures at the baseline visit.

Assessors for the KSADS-PL included six bachelors-level research assistants. Assessors for the PARDI included two doctoral-level psychologists and five bachelors-level research assistants. Prior to conducting interviews for the study, new assessors attended an initial two-hour training for each interview, observed experienced assessors conduct several interviews, and conducted practice ratings of audiotaped interviews which were reviewed by a

supervisor. Thereafter they attended weekly meetings chaired by a psychologist to address scoring questions and ensure inter-rater reliability for both interviews.

Measures

Comorbid psychopathology.—We used the KSADS-PL (Kaufman et al., 2013) to identify individuals with potential ARFID for inclusion in the study and to evaluate comorbid diagnoses in the following categories: (a) Neurodevelopmental, Disruptive, and Conduct Disorders; (b) Anxiety, Obsessive-Compulsive, and Trauma-Related Disorders; (c) Depressive and Bipolar-Related Disorders. Information about which psychiatric disorders were included in each category of disorders is presented in Table 2. Because individuals with psychotic symptoms, past-month substance use disorders, and current eating disorders other than ARFID were excluded from the study (based on information obtained from the KSADS-PL), we did not examine the frequency or correlates of (a) Schizophrenia Spectrum and Other Psychotic Disorders; or (b) Eating Disorders and Substance-Related Disorders. Percent agreement in conferring present and lifetime diagnoses was calculated based on a second coder making independent diagnoses of randomly selected cases for 10% of the current sample. Percent agreement was 96% for the anxiety, obsessive-compulsive compulsive, and trauma-related disorders category; 94% for the depressive and bipolar-related disorders category; and 100% for all other KSADS-PL diagnostic categories. The KSADS-PL also provides an assessment of suicidality (i.e., recurrent thoughts of death, suicidal ideation, suicidal acts with intention, and suicidal acts that posed an actual medical threat to life or physical condition). For this study, we coded individuals endorsing subthreshold or threshold symptoms on any of these items as 1 for suicidality, and individuals who did not endorse these items as 0 for suicidality. While current active suicidal ideation with plan or intent was an exclusion criterion, no participants were ultimately excluded from the study for this reason. Thus, data are reflective of this sample's true endorsement of KSADS-PL suicidality items.

Feeding and eating disorders.—The Eating Disorder Assessment for *DSM-5* (EDA-5; Sysko et al., 2015) is a brief, semi-structured interview specifically developed to derive *DSM-5* feeding and eating-disorder diagnoses. The EDA-5 has extensive validity data for anorexia nervosa, bulimia nervosa, binge-eating disorder, and other specified feeding or eating disorder, but little data on ARFID. Therefore, we used the EDA-5 during the screening visit to rule out the presence of eating disorders other than ARFID and also to identify individuals with potential ARFID symptoms for inclusion in the study.

To definitively confirm diagnoses of ARFID vs. subthreshold ARFID and to evaluate participants' severity on each of the three ARFID profiles, we used the Pica, ARFID, and Rumination Disorder Interview (PARDI; Bryant-Waugh et al., 2018). The PARDI is a semi-structured interview that can be used to diagnose pica, ARFID, and rumination disorder in children and adults. The PARDI provides dimensional scores for each of the three *DSM-5* ARFID profiles (i.e., sensory sensitivity, fear of aversive consequences, lack of interest in eating). Scores on the three ARFID profiles range from 0-6, with higher scores indicating greater severity in that profile. In the initial validation sample of the PARDI (which included a subset of the current sample [Bryant-Waugh et al., 2019]), inter-rater reliability of the

ARFID diagnosis was .75, and intraclass correlation coefficients of the three ARFID profiles were .99 for sensory sensitivity, .98 for fear of aversive consequences, and .99 for lack of interest. Following the PARDI diagnostic algorithm, individuals who met any of the four components of criterion A (i.e., weight loss, nutritional deficiency, dependence on enteral feeding or oral nutrition supplements, marked interference with psychosocial functioning), and also met criteria B (the eating disturbance is not explained by lack of available food or a culturally sanctioned practice), C (ARFID does not exclusively occur during the course of anorexia nervosa or bulimia nervosa and shape and weight concerns are not endorsed), and D (the eating disturbance cannot be fully explained by another medical condition or psychiatric disorder) were diagnosed with ARFID (n = 62, 84%). The remaining participants —all of whom restricted their intake by volume and/or variety and met criteria B, C, and D for ARFID but did *not* meet any of the four components of criterion A to the degree of severity required by the PARDI—were classified as having subthreshold ARFID (n = 12, 16%). These two groups were combined for data analysis.

The Eating Disorder Examination Questionnaire (EDE-Q; Fairburn and Beglin, 2008) is a self-report questionnaire that provides indices of eating psychopathology over a 28-day timeframe. In the current study we used the EDE-Q to rule out individuals with current clinically significant eating-disorder psychopathology that would preclude a diagnosis of ARFID.

Data Analyses

We undertook data analyses through two stages using IBM SPSS (version 25.0, SPSS Inc., Chicago, Illinois). For our first aim, we computed the frequency of each overarching category of psychiatric disorder on the KSADS-PL as well as the frequency of individual diagnoses within each category for both current and lifetime diagnoses. We also calculated the number of psychiatric comorbidities. To confirm that there was no problematic multicollinearity among the predictor variables for our second aim, we explored the inter-relationships between the three PARDI profiles by calculating Pearson zero-order correlations. There was a positive correlation between the fear of aversive consequences and lack of interest profiles ($r = .511$, $p < .001$), however, this correlation was below the suggested .90 threshold indicative of problematic multicollinearity (Tabachnick & Fidell, 2013). The correlations between the sensory sensitivity and fear of aversive consequences profiles ($r = -.092$, $p = .442$), and the sensory sensitivity and lack of interest profiles ($r = .038$, $p = .748$) were not statistically significant. Thus, we moved forward with simultaneously including the three PARDI profiles as covariates in the analyses. To determine whether BMI should also be included as a covariate, we examined the correlations between BMI and the three PARDI profiles. There was a negative correlation between BMI and the lack of interest profile ($r = -.312$, $p = .008$), and a marginally significant negative correlation between BMI and the fear of aversive consequences profile ($r = -.231$, $p = .051$). The correlation between BMI and the sensory sensitivity profile was not statistically significant ($r = .157$, $p = .187$). Given the different relations of BMI and the three PARDI profiles, we included BMI as a covariate in all of the following regression models. We employed eight separate binary logistic regressions (three models for each relevant KSADS-PL diagnostic category and one model for suicidality, with each of these models run twice to

assess for current and lifetime disorders and suicidality). For each model, we simultaneously entered the three PARDI profile scores as covariates. The binary criterion variables for the eight logistic regression models were No = 0, Yes = 1 for: (a) current or lifetime neurodevelopmental, disruptive, and conduct disorders; (b) current or lifetime anxiety, obsessive-compulsive, and trauma-related disorders; (c) current or lifetime depressive and bipolar-related disorders; and (d) current or lifetime suicidality. These models tested which (if any) ARFID profiles were uniquely associated with the odds of having a current or lifetime comorbid psychiatric diagnosis or suicidality (accompanied by 95% confidence intervals).

Results

Frequency of current and lifetime psychiatric diagnoses

The frequencies of current and lifetime psychiatric diagnoses and suicidality and number of co-occurring diagnoses are presented in Table 2. Overall, 45% of the sample met criteria for at least one current psychiatric disorder, and 53% of the sample met criteria for at least one lifetime co-occurring psychiatric disorder. As predicted, anxiety disorders were the most common current and lifetime psychiatric comorbidity.

Association between ARFID profiles, KSADS-PL diagnostic categories, and suicidality

Table 3 summarizes results from the logistic regression analyses for current and lifetime comorbidities and suicidality.

Neurodevelopmental, disruptive, and conduct disorders.—A binary logistic regression with all three ARFID profiles as covariates against a constant only model was not statistically significant for current (χ^2 [3] = 6.63, *Nagelkerke* R^2 = .148, p = .157) or lifetime neurodevelopmental, disruptive, and conduct disorders (χ^2 [3] = 8.06, *Nagelkerke* R^2 = .169, p = .090). However, as predicted, the ARFID sensory sensitivity profile uniquely contributed to both current and lifetime neurodevelopmental, disruptive, and conduct disorders. For both current and lifetime models, a 1-unit increase in the sensory sensitivity profile (rated on a 0-6 scale) was associated with more than twice the odds of a current or lifetime comorbid neurodevelopmental, disruptive, and conduct disorder.

Anxiety, obsessive-compulsive, and trauma-related disorders.—A test of the full model with all three ARFID profiles as covariates against a constant-only model was statistically significant for both current (χ^2 [3] = 23.8, *Nagelkerke* R^2 = .386, p < .001) and lifetime anxiety, obsessive-compulsive, and trauma-related disorders (χ^2 [3] = 27.4, *Nagelkerke* R^2 = .427, p < .001), indicating that the three ARFID profiles significantly distinguished between individuals with and without comorbid anxiety, obsessive-compulsive, and trauma-related disorders. Consistent with our hypothesis, the ARFID fear of aversive consequences profile was significantly associated with current and lifetime anxiety, obsessive-compulsive, and trauma-related comorbidities. For both current and lifetime comorbidities, a 1-unit increase in the fear of aversive consequences profile was associated with more than twice the odds of a current comorbid anxiety, obsessive-compulsive, and trauma-related disorder. Further, the ARFID sensory sensitivity profile

contributed significantly to both current and lifetime anxiety, obsessive-compulsive, and trauma-related disorders. For both models, a 1-unit increase in the sensory sensitivity profile was associated with nearly three times the odds of a current or lifetime comorbid anxiety, obsessive-compulsive, and trauma-related disorder.

Depressive and bipolar-related disorders.—A binary logistic regression with all three ARFID profiles as covariates against a constant only model was not statistically significant for current (χ^2 [3] = 1.95, *Nagelkerke* R^2 = .091, p = .744) depressive and bipolar-related disorders, but was statistically significant for lifetime depressive and bipolar-related disorders (χ^2 [3] = 19.20, *Nagelkerke* R^2 = .374, p < .001). Contrary to our hypothesis, the ARFID lack of interest profile was not uniquely associated with current or lifetime depressive and bipolar-related disorders. However, the ARFID sensory sensitivity profile uniquely contributed to lifetime depressive and bipolar-related disorders, such that a 1-unit increase in the sensory sensitivity profile was associated with more than twice the odds of a lifetime comorbid depressive and bipolar-related disorder.

Suicidality.—A binary logistic regression analysis on suicidality as the outcome and the three ARFID profiles as covariates was not statistically significant for the current (χ^2 [3] = 8.62, *Nagelkerke* R^2 = .258, p = .071) suicidality model, but was statistically significant for the lifetime suicidality model (χ^2 [3] = 10.10, *Nagelkerke* R^2 = .237, p = .038) None of the ARFID profiles were unique contributors to either model.

Discussion

The current study aimed to characterize the prevalence and correlates of current and lifetime comorbid psychiatric diagnoses and suicidality in a sample of treatment- and non-treatment seeking children and adolescents with full and subthreshold ARFID. We found that nearly half the sample met criteria for a current co-occurring psychiatric disorder, and more than half the sample met criteria for a lifetime co-occurring psychiatric disorder, with anxiety disorders being the most common diagnosis. Findings were consistent with our hypotheses in that severity in the sensory sensitivity profile contributed to both current and lifetime likelihood of neurodevelopmental, disruptive, and conduct disorders; and severity in the fear of aversive consequences profile contributed to current and lifetime anxiety, obsessive-compulsive, and trauma-related disorders. The findings of this study demonstrate the psychiatric severity of ARFID and highlight some of the shared features of ARFID and other disorders.

Overall, the prevalence of co-occurring psychiatric disorders in this study was lower than in prior studies. This is likely due to the fact that all prior studies have examined treatment-seeking samples of individuals with full-threshold ARFID (Fisher et al. 2014; Nicely et al., 2014; Norris et al., 2014; Bryson et al., 2017; Cooney et al., 2018), whereas our study also included non-treatment-seeking and subthreshold cases. Consistent with both previous findings and our hypothesis, anxiety, obsessive-compulsive, and trauma-related disorders (both current and lifetime) were the most prevalent category of diagnoses. Generalized anxiety disorder, followed by panic disorder and social anxiety disorder, were the most common both current and lifetime comorbidities in the sample as a whole. These findings

are also consistent with the high reported lifetime prevalence of anxiety disorders among the other eating disorders (Swinbourne, Hunt, Abbott, Russell, St. Clare, & Touyz, 2012).

Consistent with our hypothesis, severity of the sensory sensitivity profile was associated with a higher likelihood of both current and lifetime comorbid neurodevelopmental, disruptive, and conduct disorders. Interestingly, because only two individuals within our sample met criteria for ASD, the higher likelihood of neurodevelopmental, disruptive, and conduct disorders as a whole among individuals with a more severe sensory sensitivity profile is probably better explained by the presence of ADHD in our sample. Prior research suggests that individuals with ADHD also present with sensory processing difficulties (Cermak, 1988; Mangeot et al., 2001), which may be of similar severity to those with ASD (Cheung & Siu, 2009). Much like those with ARFID, individuals with ADHD are often hyper-sensitive and display exaggerated responses to sensory stimuli (Baranek et al., 2006), which may include the taste and texture of food. Indeed, the prevalence of ADHD among individuals presenting with the “selective eating” profile of ARFID ranged from 24% to 25% in one study that utilized two raters (Reilly et al., 2019), and from 16% (Zickgraf et al., 2019a) to 20% (Zickgraf et al., 2019b) in two studies. Exposure to sensory stimuli that produce an exaggerated response may be a relevant treatment target for those with co-occurring ARFID and neurodevelopmental disorders.

As hypothesized, greater severity in the fear of aversive consequences profile was uniquely associated with a higher likelihood of comorbid anxiety, obsessive-compulsive, and trauma-related disorders. This is consistent with a prior study that found an independent positive relationship between the Nine-Item ARFID Screen fear subscale and anxiety symptoms in a non-clinical sample (Zickgraf & Ellis, 2018), and a study that found a 77% of prevalence of anxiety disorders among individuals with the fear profile in a clinical sample (Zickgraf et al., 2019a). Additionally, greater severity in the sensory sensitivity profile was also uniquely associated with a higher likelihood of comorbid anxiety, obsessive-compulsive, and trauma-related disorders. These findings are consistent with an 80% prevalence of anxiety disorders among those exhibiting the “selective eating” profile in a clinical sample (Zickgraf et al., 2019a), as well as results from a study suggesting that anxiety and sensory sensitivity were positively correlated in a non-clinical sample of children (Farrow & Coulthard, 2012). Overall, the food avoidance exhibited by individuals with the ARFID sensory sensitivity and/or fear of aversive consequences profiles may be driven partly by anxiety, and may function to relieve anxiety, thus negatively reinforcing the avoidant behavior. Thus, avoidant behavior may be a transdiagnostic construct of ARFID and anxiety disorders. Targeting this avoidance in treatment (e.g., through exposure; Thomas & Eddy [2019]) may help address and relieve symptoms of both disorders simultaneously.

Although lack of interest in food or eating is a commonly endorsed symptom of MDD, our study did not find evidence in support of the hypothesis that individuals exhibiting severity in the lack of interest profile would have a higher likelihood of depressive and bipolar-related disorders. Instead, severity in the sensory sensitivity profile was associated with lifetime comorbid depressive and bipolar-related disorders. These findings are consistent with research suggesting that sensory processing deficits are commonly associated with

negative clinical outcomes, including depression (Liss, Timmel, Baxley, & Killingsworth, 2005), and highlight the psychiatric severity of the sensory sensitivity profile.

Interestingly, current and lifetime prevalence of suicidality was 9% and 13%, respectively, and the three ARFID profiles as a set distinguished between individuals with and without lifetime suicidality. While one prior study has examined suicidality in ARFID (Duncombe Lowe et al., 2019), this study is the first to report prevalence of suicidality in ARFID, and thus, it is unclear how our findings might compare to other populations and whether prevalence of suicidality would be higher in a solely treatment-seeking sample of full-threshold cases. Future research is warranted to clarify the prevalence of suicidality among individuals with ARFID and its relation, if any, to specific characteristics of avoidant/restrictive eating.

The findings of this study should be interpreted in light of its limitations. One, our inclusion/exclusion criteria prevented us from testing hypotheses about the presence of substance use disorders and psychotic disorders. While we excluded comorbid eating disorders due to *DSM*-5 ARFID criteria, future research should examine individuals with ARFID who develop traditional eating-disorder psychopathology (e.g., shape and weight concerns, as in Becker, Breithaupt, Lawson, Eddy, & Thomas, in press). Two, though larger than the sample sizes of several previous studies reporting on comorbidities in ARFID, our own sample size was still modest. Three, due to this being a selected sample of both treatment- and non-treatment seeking individuals participating in a specific study, findings may not be representative all individuals with full or subthreshold ARFID. Four, due to the inclusion of subthreshold ARFID in our sample, average PARDI profile scores were fairly low (i.e., indicating low profile severity [Table 1]), which may have limited statistical power for our second aim and led to a lower estimate of comorbidities than would have been reported utilizing data from only individuals with full-threshold ARFID. Five, the up to six-week gap between the KSADS-PL (screening visit) and PARDI (baseline visit) may have weakened our ability to detect associations between these measures. On the other hand, our study had several strengths. First, it is the first study to use a dimensional model of ARFID to report prevalence and correlates of current and lifetime comorbid psychiatric disorders in a sample of treatment and non-treatment seeking children and adolescents with full and subthreshold ARFID using rigorous structured interviews with strong psychometric properties. Second, it is the first study to report the prevalence of suicidality in ARFID. Third, it is the first study to test *a priori* hypotheses about unique associations between severity of three ARFID profiles and comorbid diagnostic categories.

Overall, our findings underscore the commonality of comorbid psychopathology among individuals with ARFID and related presentations, and also highlight the potential that shared psychopathology between specific ARFID profiles and other psychiatric disorders represent transdiagnostic constructs that may be relevant treatment targets.

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Table 1.

Demographic and clinical characteristics of 74 children and adolescents with full and subthreshold avoidant/restrictive food intake disorder

Characteristic	**M (*SD*)**
Age (years)	15.0 (3.5)
Adolescents <20 years old BMI percentile	32.3 (32.0)
Adults ≥ 20 years old BMI (kg/m^2)	22.8 (6.7)
PARDI ARFID Profile [a, b]	
Sensory sensitivity	1.16 (0.94)
Fear of aversive consequences	0.46 (0.94)
Lack of interest	1.61 (1.32)
Characteristic	**N (%)**
Age Group	
Adolescents < 20 years old	65 (88)
Adults ≥ 20 years old	9 (12)
Sex	
Male	38 (51)
Female	36 (49)
Ethnicity	
American Indian/Alaska Native	0 (0)
Black/African American	2 (3)
Asian	1 (1)
Native Hawaiian/other Pacific Islander	0 (0)
White	66 (89)
More than one race	5 (7)
ARFID Diagnosis	
Full threshold ARFID	62 (84)
Subthreshold ARFID	12 (16)
Received prior treatment for a feeding or eating disorder [c]	
Yes	13 (18)
No	61 (82)

BMI – body mass index; PARDI - Pica, ARFID, and Rumination Disorder Interview; ARFID – avoidant/restrictive food intake disorder

[a] n =72 participants completed the PARDI

[b] Scores on the three ARFID profiles range from 0-6, with higher scores indicating greater severity in that profile.

[c] Received prior treatment for a feeding or eating disorder refers to individuals who had ever received treatment for a feeding or eating disorder at the time of assessment. Some individuals in the no-treatment group later received and accepted referrals for outpatient treatment as a result of their participation in our research study.

Table 2.

Psychiatric comorbidities of 74 children and adolescents with full and subthreshold avoidant/restrictive food intake disorder.

KSADS-PL Diagnoses [a,b]	**Current *n*, (% of total sample)**	**Lifetime *n*, (% of total sample)**
Neurodevelopmental, Disruptive, and Conduct Disorders	12 (16)	14 (19)
Oppositional defiant disorder	2 (3)	2 (3)
Autism spectrum disorder	2 (3)	2 (3)
Attention deficit/hyperactivity disorder	6 (8)	7 (10)
Other specified attention deficit/hyperactivity disorder	5 (7)	5 (7)
With insufficient inattention/hyperactivity symptoms	4 (80)	4 (80)
Only present in one situation	1 (20)	1 (20)
Anxiety, Obsessive-Compulsive, and Trauma-Related Disorders	26 (35)	30 (41)
Generalized anxiety disorder	18 (24)	18 (24)
Panic disorder	7 (10)	9 (12)
Specific phobia [c]	5 (7)	5 (7)
Animal	1 (20)	1 (20)
Situational	3 (60)	3 (60)
Natural environment	1 (20)	1 (20)
Other (loud noises, vomiting, crowds)	3 (60)	3 (60)
Agoraphobia	1 (1)	1 (1)
Social anxiety disorder	7 (10)	9 (12)
Separation anxiety disorder	0 (0)	1 (1)
Other specified anxiety disorder	1 (1)	1 (1)
Limited symptom panic attacks	1 (100)	1 (100)
Obsessive compulsive disorder	3 (4)	3 (4)
Posttraumatic stress disorder	0 (0)	1 (1)
Depressive and Bipolar-Related Disorders	3 (4)	15 (20)
Major depressive disorder	2 (3)	10 (14)
Other specified depressive disorder	1 (1)	3 (4)
Depressive episode with insufficient symptoms	1 (100)	3 (100)
Persistent depressive disorder	0 (0)	2 (3)
Schizophrenia Spectrum and Other Psychotic Disorders	0 (0)	0 (0)

KSADS-PL Diagnoses [a, b]	Current *n*, (% of total sample)	Lifetime *n*, (% of total sample)
Eating Disorders and Substance-Related Disorders [e]	0 (0)	1 (1)
Binge eating disorder	0 (0)	1 (1)
Suicidality [d]	6 (8)	10 (14)
Number of psychiatric comorbidities		
0	41 (55)	35 (47)
1	19 (26)	17 (23)
2	5 (7)	9 (12)
3	6 (8)	7 (10)
4	2 (3)	4 (5)
5	1 (1)	2 (3)

KSADS-PL – Kiddie Schedule for Affective Disorders and Schizophrenia for School Age Children – Present and Lifetime Version

[a] Frequencies of individual diagnoses reflect the number of individuals with that diagnosis. KSADS-PL diagnostic categories and suicidality reflect the number of people who met criteria for *any* diagnosis within that category.

[b] The following KSADS-PL current and lifetime diagnoses were assessed but not endorsed by any participants in this sample: **Depressive and Bipolar-Related Disorders** – mood disorder with psychotic features, disruptive mood dysregulation disorder, bipolar I disorder, bipolar II disorder, cyclothymic disorder, unspecified/other specified bipolar and related disorder; **Schizophrenia Spectrum and Other Psychotic Disorders** – schizophrenia, schizoaffective disorder, schizophreniform disorder, brief reactive psychosis; **Anxiety, Obsessive-Compulsive, and Trauma-Related Disorders** – selective mutism, acute stress disorder, adjustment disorder; **Neurodevelopmental, Disruptive, and Conduct Disorders** – conduct disorder, chronic motor or vocal tic disorder, transient tic disorder, Tourette's disorder; **Eating Disorders and Substance-Related Disorders** – anorexia nervosa, bulimia nervosa, alcohol use disorder, substance use disorder

[c] 3 participants endorsed more than one specific phobia.

[d] Suicidality refers to subthreshold or threshold endorsement of any of the four KSADS-PL suicidality items (i.e., recurrent thoughts of death, suicidal ideation, suicidal acts with intention, or suicidal acts that posed an actual medical threat to life or physical condition).

[e] While current eating disorders other than ARFID were excluded from the study, one individual met criteria for a past diagnosis of binge eating disorder and was thus included in the sample.

Table 3.

Logistic regression analyses for current and lifetime psychiatric comorbidities and suicidality with the three ARFID profiles as covariates in 72 children and adolescents with full and subthreshold avoidant/restrictive food intake disorder

KSADS-PL Binary Criterion Variables	ARFID PARDI Profile	*B*	SE	*p*	OR [95% CI]
Current Neurodevelopmental, Disruptive, and Conduct Disorders [a]	BMI	−.04	.07	.606	.96 [.84, 1.11]
	Sensory sensitivity	.85	.36	**.019** *	2.33 [1.15, 4.72]
	Fear of aversive consequences	.30	.45	.513	1.35 [.55, 3.28]
	Lack of interest	−.37	.35	.293	.69 [.34, 1.38]
Lifetime Neurodevelopmental, Disruptive, and Conduct Disorders [b]	BMI	−.06	.07	.397	.94 [.82, 1.08]
	Sensory sensitivity	.92	.35	**.009** *	2.50 [1.26, 4.99]
	Fear of aversive consequences	.29	.41	.467	1.34 [.61, 2.97]
	Lack of interest	−.26	.33	.433	.78 [.41, 1.47]
Current Anxiety, Obsessive-Compulsive, and Trauma-Related Disorders [a]	BMI	.15	.06	**.012** *	1.17 [1.03, 1.31]
	Sensory sensitivity	1.05	.36	**.003** *	2.85 [1.42, 5.72]
	Fear of aversive consequences	.87	.37	**.020** *	2.38 [1.14, 4.95]
	Lack of interest	.12	.28	.680	1.12 [.65, 1.94]
Lifetime Anxiety, Obsessive-Compulsive, and Trauma-Related Disorders [b]	BMI	.18	.07	**.006** *	1.20 [1.05, 1.36]
	Sensory sensitivity	1.06	.36	**.003** *	2.90 [1.44, 5.84]
	Fear of aversive consequences	.78	.38	**.039** *	2.18 [1.04, 4.58]
	Lack of interest	.36	.28	.188	1.44 [.84, 2.47]
Current Depressive and Bipolar-Related Disorders [a]	BMI	.10	.09	.273	1.10 [.93, 1.31]
	Sensory sensitivity	.21	.61	.731	1.23 [.37, 4.08]
	Fear of aversive consequences	−.58	1.48	.697	.56 [.03, 10.14]
	Lack of interest	−.02	.59	.972	.98 [.31, 3.11]
Lifetime Depressive and Bipolar-Related Disorders [b]	BMI	.22	.07	**.002** *	1.24 [1.08, 1.43]
	Sensory sensitivity	.82	.38	**.031** *	2.27 [1.08, 4.77]
	Fear of aversive consequences	−.48	.57	.396	.62 [.20, 1.88]
	Lack of interest	.51	.34	.128	1.67 [.86, 3.23]

KSADS-PL Binary Criterion Variables	ARFID PARDI Profile	*B*	SE	*p*	OR [95% CI]
Current Suicidality [a]	BMI	.12	.07	.088	1.13 [.98, 1.30]
	Sensory sensitivity	.70	.45	.121	2.02 [.83, 4.89]
	Fear of aversive consequences	−2.27	3.06	.459	.10 [.00, 41.94]
	Lack of interest	.00	.45	.991	1.00 [.41, 2.39]
Lifetime Suicidality [b]	BMI	.10	.06	.096	1.10 [.98, 1.24]
	Sensory sensitivity	.50	.37	.175	1.65 [.80, 3.39]
	Fear of aversive consequences	−2.76	2.75	.315	.06 [.00, 13.83]
	Lack of interest	.01	.34	.975	1.01 [.52, 1.98]

KSADS-PL - Kiddie Schedule for Affective Disorders and Schizophrenia for School Age Children – Present and Lifetime Version; ARFID – avoidant/restrictive food intake disorder; PARDI – Pica, ARFID, and Rumination Disorder Interview

[a] Outcome variable is presence of current KSADS-PL diagnostic category or suicidality

[b] Outcome variable is presence of lifetime KSADS-PL diagnostic category or suicidality

[*] Bolded *p*-values indicate those that met our threshold for statistical significance of $p < .05$.