



# Restrictive eating disorders in children and adolescents: a comparison between clinical and psychopathological profiles

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## Abstract

**Purpose** DSM-5 describe three forms of restrictive and selective eating: Anorexia Nervosa-Restrictive (AN-R), Anorexia Nervosa-Atypical (AN-A), and Avoidant/Restrictive Food Intake Disorder (ARFID). While AN is widely studied, the psychopathological differences among these three diseases are not clear. The aim of this study was to (i) compare the clinical features of AN-R, AN-A, and ARFID, in a clinical sample recruited from a specialized EDs program within a tertiary care children's Hospital; (ii) identifying three specific symptom profiles, to better understand if restrictive ED share a common psychopathological basis.

**Methods** Data were collected retrospectively. Psychometric assessment included: the Children's Depression Inventory (CDI), the Multidimensional Anxiety Scale for Children (MASC), the Child Behavior Checklist (CBCL), and the Eating Disorder Inventory-3 (EDI-3).

**Results** A final sample of 346 children and adolescent patients were analyzed: AN-R was the most frequent subtype (55.8%), followed by ARFID (27.2%) and AN-A (17%). Patients with ARFID presented different features from AN-R and AN-A, characterized by lower weight and medical impairment, younger age at onset, and a frequent association with separation anxiety and ADHD symptoms. EDI-3 profiles showed specific different impairment for both AN groups compared to ARFID. However, no differences was detected for items: 'Interpersonal Insecurity', 'Interoceptive Deficits', 'Emotional Dysregulation', and 'Maturity Fears'.

**Conclusions** Different ED profiles was found for the three groups, but they share the same general psychopathological vulnerability, which could be at the core of EDs in adolescence.

**Level of evidence** III. Evidence obtained from case-control analytic studies.

**Keywords** ARFID · Atypical anorexia nervosa · Anorexia nervosa · Avoidant-restrictive food intake disorder · Childhood · Adolescence

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## Introduction

Food problems are common in children and adolescents. However, they may appear in transitory forms and tend to self-resolution, other times they persist and are configured as a full-blown Eating Disorder (ED). It seems that 63% of children with ED problems maintain moderate-to-severe malnutrition or migrate to Anorexia Nervosa (AN) condition in adolescence or adult age [1, 2], almost indicating that, at least for a percentage of patients, avoidant or selective eating behaviors that occur in early age may be a precursor for AN in adolescence [1]. Therefore, it seems useful to see how the different restrictive EDs contrast or are similar in clinical manifestation and which symptoms profiles may have relevance for patients with eating selectivity to better understand the symptomatic core at the basis of the clinical manifestation. The new DSM-5 [3] divides restrictive EDs into three major forms: Anorexia Nervosa-Restrictive (AN-R), Anorexia Nervosa-Atypical (AN-A), and Avoidant/Restrictive Food Intake Disorder (ARFID). Although these forms present a common element in terms of very restricted food intake and resultant weight loss or faltering growth, motivations underlying the three disorders differ markedly [3].

In the AN-R group, the reduction of caloric intake is aimed at weight loss, strongly desired by the patient to pursue an unattainable ideal of thinness; so also in the AN-A group, where, however, the weight loss never reaches the severity levels of the AN-R, because the patients start from a greater weight base point. This form of anorexia appears to be less known and less described in the literature, probably because the affected patients less frequently come to clinical attention. However, the organic and psychological implications of affected patients can be very serious [4]. On the contrary, in the ARFID group, weight loss is not a goal deliberately achieved by the patient, but a consequence of a food restriction due to other factors, such as lack of interest in food, sensory preference, or fear of adverse consequences (such as suffocating).

While several studies on psychogenic EDs such as AN types have been reported in the literature, there is essentially no available studies comparing AN-R and AN-A, and little is known about the psychopathological symptomatology underlying ARFID.

Recent works highlight that AN-R and AN-A have many similarities and present the same severe medical complications [5–7]. The only differences that stand out are the patient's weight and the distorted body image element. When patients with atypical AN see themselves as being overweight or obese, these perceptions are often true based on BMI standards [5]. However, it is not clear whether patients with atypical AN have more denial than

those with AN-R, thus perceiving their weight loss as less severe, as they may have struggled or been encouraged to lose weight. Finally, both AN-R and AN-A are known to be strongly associated with affective, anxiety, and obsessive-compulsive disorders as well as substance abuse [8–13], but the different prevalence of this comorbidities and the specific psychopathological profile between the two disorders is unclear.

Currently, the literature on ARFID is consistent, so much so, that clear features can be outlined: compared with patients affected by AN, ARFID presented a lower onset age, a lower frequency of behaviors traditionally associated with AN, comorbidity and bradycardia, and a lower weight loss [1, 14–19]. However, ARFID is heterogeneous in presentation, and may require both medical and psychological management [20, 21]. Prevalence is between 5 and 22% and has a greater presence in males than females [1, 15]. Unlike AN-R and AN-A, it seems that ARFID is more frequently associated with anxiety disorders and neurodevelopmental disorders such as Attention Deficit/Hyperactivity Disorder and Autism Spectrum Disorder [14, 22–25].

The aim of this study is (i) to compare the clinical features of AN-R, AN-A, and ARFID, in a clinical sample recruited from a specialized EDs program within a tertiary care children's Hospital; (ii) and to identify three specific symptoms profiles, to better understand if restrictive ED share a common psychopathological basis. Concerning the psychopathology, we expect patients with ARFID to show greater symptoms on the anxious side, compared to patients with AN, who we expect to be more prone to the depressive side [14, 19, 26]. Furthermore, we expect that the profile between AN-R and AN-A is relatively similar respect to food symptoms, but different in body weight and in psychopathology [5–7]. Finally, we hypothesize the three disorders may share some psychopathological characteristics, on an interpersonal and emotional level, which could, therefore, represent the patients' common areas of greatest vulnerability.

## Methods

A retrospective chart review was completed. All patients under the age of 18 years who received a DSM-IV primary diagnosis of Anorexia Nervosa, Feeding Disorder of Infancy or Early Childhood or Eating Disorder Not Otherwise Specified, in a specialized ED program within an Italian tertiary care children's Hospital between January 2010 and September 2017, were selected. A comprehensive assessment, consisting of a diagnostic evaluation with the patient and their family members, was conducted by a multidisciplinary équipe. They were performed in three different days and was composed of: an anthropometric and clinical evaluation, a psychiatric, family, psychopathological

and nutritional interview, and a psychological and eating test administration [27]. Diagnosis and psychiatric comorbidities were formulated with the Italian version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children/Present and Lifetime Version (K-SADS-PL, [28]), which follows DSM-IV criteria. Either concurrently or retrospectively, a presumptive recodification of the diagnosis from DSM-IV to DSM-5 was conducted by a psychiatrist, expert in EDs, using a diagnostic checklist based on the DSM-5 diagnostic criteria, as previously done by Ornstein (Table 1; [16]).

Patients who met the DSM-5 criteria for AN-R, ARFID, and AN-A were included in the analysis for the present

study. Patients diagnosed for intellectual disabilities, pervasive developmental disorders, schizophrenia spectrum disorders, or associated neurological conditions were not included.

### Sociodemographic and clinical variables at admission

Sociodemographic and clinical variables used for the present study included: nationality, age, gender, vital signs, presence of coexisting medical conditions, history of psychiatric diagnosis, family history of ED, or other psychiatric diagnosis. Data were collected retrospectively using information

**Table 1** Table of diagnosis recoding from DSM-IV TR to DSM-5

DSM-IV TR	DSM-5
<i>Restrictive Anorexia Nervosa (AN-R)</i>	<i>Restrictive Anorexia Nervosa (AN-R)</i>
Refusal to maintain body weight at or above a minimally normal weight for age and height	Body weight lower than the minimum weight expected for age and height (pBMI < 5 <sup>th</sup> )
Intense fear of gaining weight or becoming fat, even though underweight	Intense fear of weight gain
Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight	Alteration in the way in which one's body image is perceived
In postmenarcheal females, amenorrhea, i.e., the absence of at least three consecutive menstrual cycles	Excessive influence of the body image in the attribution of personal value
Restricting type: during the current episode of Anorexia Nervosa, the person has not regularly engaged in binge eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)	Restricting type: During the last 3 months, the individual has not engaged in recurrent episodes of binge eating or purging behavior (i.e., self-induced vomiting, or the misuse of laxatives, diuretics, or enemas). This subtype describes presentations in which weight loss is accomplished primarily through dieting, fasting and/or excessive exercise
<i>Eating Disorder Not Otherwise Specified (EDNOS)</i>	<i>Other Specified Feeding or Eating Disorder</i>
Eating disorders that do not meet the criteria for any specific eating disorder. Examples include:	Symptoms characteristic of a feeding or eating disorder that cause clinical distress or impairment in social, occupational, or other important areas of functioning predominate. However do not meet the full criteria for any of the disorders in the feeding and eating disorders diagnostic class
For females, all of the criteria for anorexia nervosa are met except that the individual has regular menses	Atypical Anorexia Nervosa (AN-A): all of the criteria for Anorexia Nervosa are met, except that despite significant weight loss, the individual's weight is within or above the normal range
All of the criteria for anorexia nervosa are met except that, despite significant weight loss, the individual's current weight is in the normal range	
<i>Feeding Disorder of Infancy or Early Childhood</i>	<i>Avoidant/Restrictive Food Intake Disorder (ARFID)</i>
Feeding disturbance as manifested by persistent failure to eat adequately with significant failure to gain weight or significant loss of weight over at least 1 month	Failure to comply with an appropriate nutritional and/or energy requirement (due to apparent lack of interest in food or avoidance of food based on sensory characteristics or concern for unpleasant characteristics or concern for unpleasant consequences resulting from meals)
The disturbance is not due to an associated gastrointestinal or other general medical condition (e.g., esophageal reflux)	Significant weight loss
The disturbance is not better accounted for by another mental disorder (e.g., Rumination Disorder) or by lack of available food.	Significant nutritional deficiency
The onset is before age 6 years	Addiction to enteral nutrition or oral nutritional supports Marked interference with psychosocial functioning

included in the patient's medical record at the time of the assessment.

### Anthropometrics

Weight and height were measured by nursing staff. Then, percentile Body Mass Index for age (pBMI) was determined using the 2000 Centers for Disease Control and Prevention growth charts (CDCP). pBMI shows how the child's weight compares to that of other children of the same age and sex. According to CDCP weight status categories and DSM-5 criteria, pBMI < 5th centile was used to identify the underweight condition for AN-R.

### Psychometric measures

The assessment includes (i) a psychometric battery of tests: the Children's Depression Inventory (CDI), the Multidimensional Anxiety Scale for Children (MASC), the Child Behavior Checklist (CBCL), and the Eating Disorder Inventory-3 (EDI-3); (ii) the K-SADS-PL interview.

The Italian version of CDI was used to evaluate depression in children and adolescents aged 7–17 years [29]. It is a 27-item self-report that consists of four subscales: negative mood, negative self-esteem, interpersonal problems and total score. 19-point cut-off indicates the ideal threshold for a child at risk of depression. Data from specific subscales of the CDI were not analyzed individually, only the CDI index was used. The MASC is a 39-item self-report measure used to assess anxiety in ages 8–19 years [30]. It includes four scales: Physical symptoms, Harm avoidance, Social anxiety, and Separation/Panic. It also measures Total Anxiety. Raw scores were converted into standard T scores and a T score more than 70 indicated the presence of anxiety symptoms.

Parents completed the *Child Behavior Checklist* [31]. The CBCL is a 113-item informant-report questionnaire assessing behavioral competency and behavioral problems in children (aged 6–18 years) within the past 6 months. The following DSM-oriented scales are assessed: Affective Problems, Anxiety Problems, Somatic Problems, Attention Deficit/Hyperactivity Problems, Oppositional Defiant Problems, and Conduct Problems. Behaviors are rated on a three-point scale: 0—Not true (as far as you know), 1—Somewhat or sometimes true, 2—Very true or often true. Reliability and validity of the Italian version have been shown to be satisfactory [32].

The EDI-3 is a self-report measure of psychological traits in individuals with EDs aged 13–53 years [33]. It has 91 items organized into 12 primary scales, three of which are ED specific: Drive for Thinness, Bulimia, and Body Dissatisfaction. Nine are general psychological scales: Low Self-Esteem, Personal Alienation, Interpersonal Insecurity,

Interpersonal Alienation, Interoceptive Deficits, Emotional Dysregulation, Perfectionism, Asceticism, and Maturity Fears. The Italian version of EDI-3 [34] has demonstrated very good day test–retest reliability, cross-informant agreement, and a good discriminating validity. Analysis of the EDI-3 questionnaire profiles is limited to the 13–18-year-old age group, according to the questionnaire administration criteria.

The *K-SADS-PL* is a semi-structured interview used to determine Axis I psychiatric diagnoses. It was administered by a trained psychologist to the patient and his/her parents. It is composed of: an introductory interview, a screen interview, and five diagnostic supplements. Items are scored using a 0–3 or 0–2 point rating scale: 0 indicates no information is available, 1 suggests the symptom is not present, 2 indicates subthreshold levels of symptomatology, and 3 represents threshold criteria. Moreover, the C-GAS scale evaluates the global functioning of the patient [28].

### Statistical analysis

Descriptive statistics were used to describe the distribution of restrictive EDs in a clinical sample recruited from a specialized pediatric ED center. To provide information about internal consistency of the scales used in this study, Cronbach's alpha was computed for MASC (0.68), CBCL (0.94), and EDI-3 (0.89). To compare the clinical features of ARFID, AN-R, AN-A, ANOVA for correlated samples was applied for each scale, with Item or Sub-Scale as within-subjects factor and Group as between-subjects factor, allowing to assess the main effects as well as the interaction "Item (Sub-Scale) X Group". To reduce the risk of false-positive findings, when the assumption of sphericity was violated, the Greenhouse–Geisser correction was applied to degrees-of-freedom. We applied Bonferroni correction both at analysis level (adjusting  $p$  value considering four analyses: CBCL, MASC, CDI, and EDI, thus considering significant when  $p$  values of F statistic was below  $0.05/4 = 0.0125$ ) and within each ANOVA ( $p$  values are already adjusted by SPSS procedure). Only the significant post hoc analysis results were reported in the tables.

### Results

During the study period, 436 patients with a primary DSM-IV diagnosis for EDs were selected. The diagnosis was recoded according to DSM-5 criteria (Table 1), and then, 90 patients were excluded as they had a DSM-5 diagnosis different to "restrictive" ED (17 AN-BP, 36 BN, 14 BED, and 23 OSFED). At the end, 346 patients were included in the study sample: 193 (55.8%) were AN-R, 94 (27.2%)

ARFID and 59 (17%) AN-A. The mean age was 15.8 years ( $SD=2.5$ ), with a higher prevalence of females (83%).

### Sociodemographic and clinical variables at admission

As shown in detail on Table 2, patients with ARFID are younger than those with other restrictive EDs ( $p < 0.001$ ), have a lower percentage of females ( $p \leq 0.001$ ), and show a higher heart rate than AN-R and AN-A ( $p < 0.001$ ). In addition, they have higher comorbidity of anxiety disorders ( $p < 0.001$ ) while the differences in depressive comorbidity are not strong ( $p = 0.075$ ). No significant differences emerge between groups for psychiatric familiarity ( $p = 0.174$ ).

### Anthropometrics

pBMI is different between all groups with averages of 1.3rd centile for AN-R, 18.9th centile for ARFID, and 48th centile for AN-A ( $p \leq 0.001$ ). In other words, in our sample, patients with AN-R have a BMI on average lower than 98.7% of children of the same age and gender. Similarly, patients with ARFID have a BMI on average lower than 81.1% of their peers and patients with AN-A show an average BMI in line with 48% of their peers.

### General psychopathology

As reported in Table 3, patients with ARFID report higher scores for item ‘Separation/Panic’ on the MASC test compared to patients with AN-R ( $F=4.322$ ,  $p < 0.001$ ), but there were no significant differences for other items.

Total CDI scores were lower in ARFID group compared to the other two diagnostic categories ( $F=8.000$ ,  $p < 0.001$ ).

Parental reports on the CBCL show that patients with ARFID had significantly more Attention Deficit/Hyperactivity Problems ( $p = 0.003$ ) than those with AN-R, while in AN-R group, higher scores are shown for the item Obsessive–Compulsive Problems ( $p = 0.008$ ) compared to the ARFID group.

### Symptoms profiles of eating disorders

The results of psychopathological evaluation with EDI-3 (Table 4) show that many of the subscale scores are different for the three groups ( $p < 0.001$ ). In general, higher scores were found in the AN-A group, followed by the AN-R group and finally the ARFID group (Fig. 1).

Large differences were found for ‘Drive for Thinness’ (DT), ‘Bulimia’ (B), ‘Body Dissatisfaction’ (BD), ‘Low Self-Esteem’ (LSE), ‘Personal Alienation’ (PA), ‘Interpersonal Alienation’ (IA), ‘Perfectionism’ (P), and ‘Ascetism’ (A). In particular, ‘Drive for Thinness’, ‘Bulimia’ and ‘Body Dissatisfaction’ scales are higher in the AN-A group,

**Table 2** Sociodemographic and clinical variables

	AN-R ( <i>N</i> = 193)	AN-A ( <i>N</i> = 59)	ARFID ( <i>N</i> = 94)	ANOVA	Post hoc comparisons (Bonferroni adjusted <i>p</i> value)
Patient clinical characteristics					
Age of onset (years), mean (SD)	15.0 (1.9)	14.8 (1.8)	10.6 (2.9)	$F(2,343) = 134.1$ , $p < .001$	ARFID vs. AN-R, $p < .001$ ARFID vs. AN-A, $p < .001$
BMI (kg/m <sup>2</sup> ), mean (SD)	14.9 (1.3)	19.8 (2.2)	15.2 (2.2)	$F(2, 343) = 185.8$ , $p < .001$	ARFID vs. AN-A, $p < .001$ AN-R vs. AN-A, $p < .001$
pBMI, mean (SD)	1.3 (1.5)	48.0 (22.0)	18.9 (23.3)	$F(2, 343) = 222.2$ , $p < .001$	ARFID vs. AN-R, $p < .001$ ARFID vs. AN-A, $p < .001$ AN-R vs. AN-A, $p < .001$
HR (SD)	62.0 (16.6)	69.6 (14.7)	79.2 (17.3)	$F(2, 343) = 30.1$ , $p < .001$	ARFID vs. AN-R, $p < .001$ ARFID vs. AN-A, $p = .004$ AN-R vs. AN-A, $p = .013$
Female, <i>n</i> (%)	172 (89.1%)	53 (90%)	62 (66.0%)	Chi square(2) = 26.4, $p < .001$	ARFID vs. AN-R, $p < .001$ ARFID vs. AN-A, $p < .003$
NPI familiarity, <i>n</i> (%)	85 (44.0%)	25 (42.0%)	30 (32.0%)	Chi square(2) = 3.49, $p = .174$	–
Psychiatric comorbidities (%)					
Mood disorder, <i>n</i> (%)	54 (28.0%)	16 (27.1%)	15 (16.0%)	Chi square(2) = 5.18, $p = 0.075$	–
Anxiety disorder, <i>n</i> (%)	28 (14.5%)	17 (28.8%)	33 (35.1%)	Chi square(2) = 16.9, $p < .001$	ARFID vs. AN-R, $p < .001$

AN-R restrictive anorexia nervosa, atypical anorexia nervosa AN-A, ARFID avoidant/restrictive food intake disorder, SD standard deviation, pBMI percentile body mass index, HR heart rate, NPI Familiarity neuropsychiatric familiarity

**Table 3** General psychopathology

	AN-R				AN-A				ARFID				General linear model			
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	Group main effect	Significant post hoc comparisons ( <i>p</i> value; Cohen's <i>d</i> )	Group X Item interaction	Significant post hoc comparisons ( <i>p</i> value; Cohen's <i>d</i> )
CBCL (T score)	158	67.7	9.8	53	67.8	10.0	81	66.1	7.9	81	66.1	7.9	$F(2;278)=0.017,$ $p=0.983$	$F(9.9;1375.7)=4.893,$ $p<0.001$	-	
	157	62.8	9.0	53	61.7	7.7	81	64.8	8.5	81	64.8	8.5	-	-	-	
	157	59.2	10.3	53	58.7	8.0	79	61.8	8.4	79	61.8	8.4	-	-	-	
	157	53.1	6.8	53	53.7	5.1	80	55.9	6.4	80	55.9	6.4	-	-	ARFID > ANR (0.003; 0.44)	
	157	56.7	8.3	53	57.4	6.4	80	56.5	6.2	80	56.5	6.2	-	-	-	
	157	54.8	8.1	53	55.1	5.8	78	55.2	5.7	78	55.2	5.7	-	-	-	
	151	57.2	9.2	53	57.9	7.7	77	57.7	7.1	77	57.7	7.1	-	-	-	
	157	65.5	12.4	53	65.0	9.9	79	61.1	9.4	79	61.1	9.4	-	-	ARFID < ANR (0.008; 0.44)	
	157	66.1	11.6	53	64.4	10.9	79	64.7	10.1	79	64.7	10.1	-	-	-	
	158	60.8	9.1	53	60.6	9.1	80	60.5	8.9	80	60.5	8.9	$F(2;287)=0.033,$ $p=0.967$	-	-	-
MASC (T score)	175	51.7	9.9	57	51.6	9.0	74	49.5	10.6	74	49.5	10.6	$F(2;303)=0.074,$ $p=0.929$	$F(5.8;875.5)=4.322,$ $p<0.001$	-	
	175	41.8	10.7	57	40.6	10.2	74	41.5	10.6	74	41.5	10.6	-	-	-	
	175	53.5	11.5	57	53.6	11.7	74	50.3	13.3	74	50.3	13.3	-	-	-	
	175	49.8	11.3	57	49.7	9.9	74	54.2	11.9	74	54.2	11.9	-	-	ARFID > ANR (0.015; 0.38)	
CDI (raw score)	175	49.9	11.1	57	49.1	9.8	74	49.9	10.3	74	49.9	10.3	$F(2;303)=0.132,$ $p=0.877$	-	-	-
	172	46.5	11.6	57	46.7	12.3	74	46.6	11.5	74	46.6	11.5	$F(2;300)=0.005,$ $p=0.995$	-	-	-
Total	173	14.5	8.6	53	15.2	8.4	74	10.3	7.2	74	10.3	7.2	$F(2;297)=8.000,$ $p<0.001$	ARFID < ANR (0.001; 0.53) ARFID < ANA (0.003; 0.63)	-	-

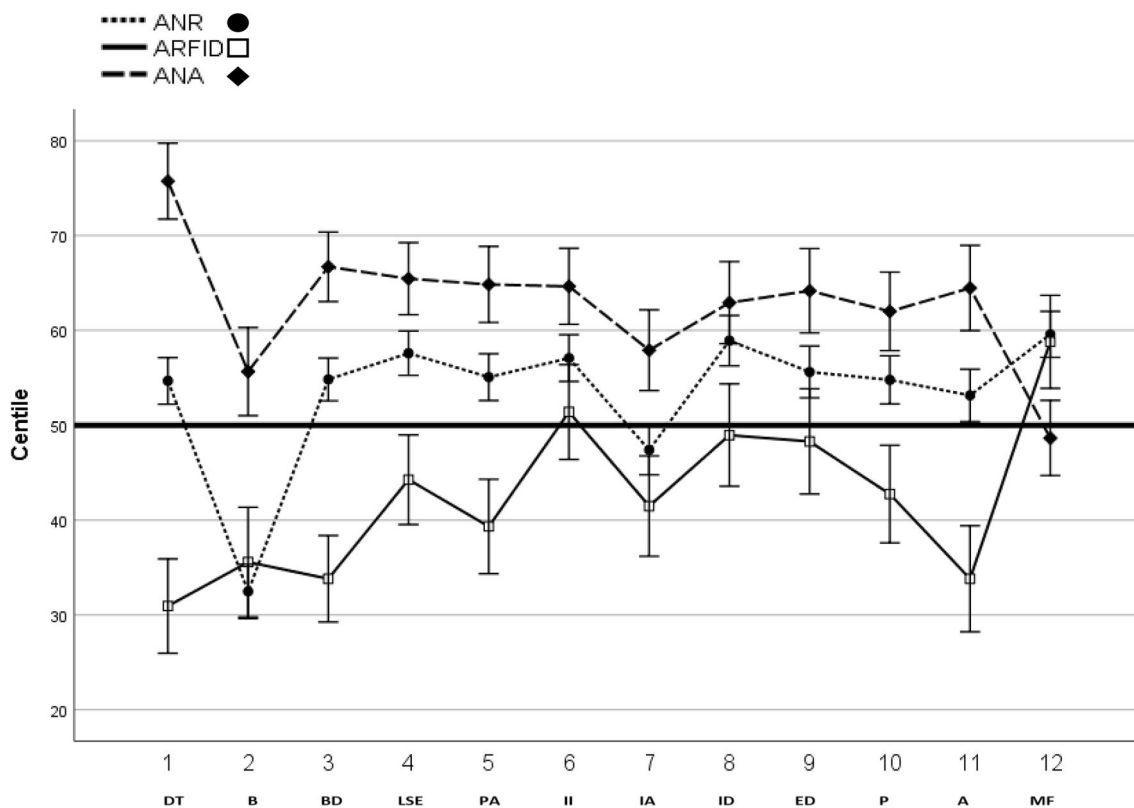
AN-R restrictive anorexia nervosa, AN-A atypical anorexia nervosa, ARFID avoidant/restrictive food intake disorder, SD standard deviation



**Table 4** EDI-3 centile scores between AN-R, AN-A, and ARFID

	AN-R		AN-A		ARFID		General linear model		Significant post hoc comparisons ( <i>p</i> value; Cohen's <i>d</i> )
	N	Mean SD	N	Mean SD	N	Mean SD	Group main effect	Group X Item interaction	
1. Drive for Thinness (DT)	138	54.5 30.6	52 75.8 22.8	33 30.9 28.2	$F(2;216)=10.708$ , $p < 0.001$	ANA > ANR (0.013; 0.47) ARFID < ANR (0.014; 0.55) ARFID < ANA (<0.001; 1.03)	$F(17.3, 1871.9)=4.637$ , $p < 0.001$	ARFID < ANR (<0.001; 0.81) ARFID < ANA (<0.001; 1.75) ANA > ANR (<0.001; 0.79) ARFID < ANA (0.022; 0.59) ANA > ANR (<0.001; 0.69) ARFID < ANR (<0.001; 0.82) ARFID < ANA (0.001; 1.27) ANA > ANR (0.019; 0.45) ARFID < ANR (0.037; 0.48) ARFID < ANA (0.002; 0.75) ARFID < ANR (0.015; 0.53) ARFID < ANA (<0.001; 0.88)	
2. Bulimia (B)	138	32.5 32.7	52 56.3 34.8	33 35.6 32.7					
3. Body Dissatisfaction (BD)	138	54.6 26.4	52 67.0 26.6	33 33.8 24.8					
4. Low Self-Esteem (LSE)	137	57.8 26.4	52 65.1 27.5	33 44.3 29.1					
5. Personal Alienation (PA)	138	55.2 29.0	52 65.0 26.9	33 39.3 30.8					
6. Interpersonal Insecurity (II)	137	57.4 28.0	52 64.8 29.8	33 51.4 29.1					
7. Interpersonal Alienation (IA)	137	47.2 30.5	52 57.7 31.4	33 41.5 28.6					
8. Interceptive Deficits (ID)	136	58.5 31.1	52 63.2 29.1	33 49.0 33.6					
9. Emotional Dysregulation (ED)	137	55.3 30.8	51 64.2 32.0	33 48.3 35.9					
10. Perfectionism (P)	137	54.6 31.5	51 62.0 24.7	33 42.8 29.4					
11. Asceticism (A)	138	54.1 32.3	52 64.8 31.5	33 33.8 33.1					
12. Maturity Fears (MF)	137	59.6 27.6	52 48.9 28.5	33 58.8 30.7					

AN-R restrictive anorexia nervosa, AN-A atypical anorexia nervosa, ARFID avoidant/restrictive food intake disorder



**Fig. 1** Comparison between EDI-3 psychopathological profiles of AN-R, AN-A and ARFID. *EDI-3* eating disorder inventory-3, *AN-R* restrictive anorexia nervosa, *AN-A* atypical anorexia nervosa, *ARFID* avoidant/restrictive food intake disorder, *DT* drive for thinness, *B*

bulimia, *BD* body dissatisfaction, *LSE* low self-esteem, *PA* personal alienation, *II* interpersonal insecurity, *IA* interpersonal alienation, *ID* interoceptive deficits, *ED* emotional dysregulation, *P* perfectionism, *A* ascetism, *MF* maturity fears

followed by the AN-R group and the ARFID group. There was also a difference for ‘Low Self-Esteem’, ‘Personal Alienation’, ‘Interpersonal Alienation’, ‘Perfectionism’, and ‘Ascetism’ scales that present lower scores in the ARFID group, while there were non-significant differences between the AN-R group and the AN-A group.

No differences were detected between the three groups for the scales ‘Interpersonal Insecurity’ (II), ‘Interoceptive Deficits’ (ID), ‘Emotional Dysregulation’ (ED), and ‘Maturity Fears’ (MF).

## Discussion

Data from our study show that among the sample of children and adolescents restrictive ED inpatient, AN-R is the most frequent subtype (55.8%), followed by ARFID (27.2%) and AN-A (17%).

Considering the medical parameters, pBMI values show a normal range for patients with AN-A and a severe underweight for AN-R, as we expected. However, results also show a healthy weight for ARFID, even if in the lower end of the range. This data contrast with part of the literature

on ARFID [1, 35] that show no differences between AN-R and ARFID weight. These studies have used absolute BMI, that is the relationship between weight and height, but not related to age and gender. Our results leads us to underline the importance of using pBMI to assess ED in childhood and not absolute BMI value, because BMI value is not always reliable, and there is the risk of under- or overestimating the underweight severity [36].

Patients who suffer of ARFID are younger than AN-R and AN-A patients [14, 15] and display stable restrictive eating patterns over time which does not cause an important weight loss, unlike in typical AN-R and AN-A patients. These characteristics could explain the higher HR that emerges in the ARFID group in comparison with the other two groups [35, 37].

Consistent with other studies [14, 23, 26, 35], the ARFID group more frequently presents a comorbidity with anxiety disorders than compared to the other two groups. Parents’ reports of patients with ARFID highlight, in particular, separation anxiety, suggestive of the difficulty these children have with detaching themselves safely from parents. This is in line with a recent study which indicates that worries and anxiety in childhood are a possible predictor of diagnoses of AN and EDs in adolescence [38].



An interesting finding of our study is the greater presence in parental reports of Attention Deficit Hyperactivity Disorder (ADHD) behaviors in the ARFID group than the other two groups. These data, although partly compatible with the literature [25, 39–42], should be investigated through an ADHD-specific diagnostic assessment to be better understood. The correlation between ADHD and ARFID is also found in other recent studies even if the explanation is not yet clear [19].

We could be hypothesized the presence of an association between ARFID and ADHD, which could probably be influenced by the characteristic of our sample, which recognizes a greater presence of males in ARFID group. In fact, ADHD, one of the most prevalent childhood disorders today, is generally more likely to be diagnosed in boys than in girls [43, 44]. Moreover, anxiety disorders are more frequent in ADHD [45] and in ED disorders [38]. Therefore, it is possible that this result highlights a higher frequency of anxiety and ADHD symptoms in ARFID patients, or simply a correlation between anxiety and ARFID, since within ADHD subscale of CBCL symptomatology of lack of attention and concentration, forgetfulness, daydreaming, impulsiveness, and dependency are evaluated and many of these symptoms are common to both anxiety and inattention.

The second objective was to compare the clinical features of AN-R, AN-A, and ARFID, identifying a symptoms profile associated with EDs. According to literature and clinical characteristics, the three groups have a similar profile, which differs in severity of score compared to the EDI scales: AN-A has a more severe profile, since the three items of the ‘Drive for Thinness’, ‘Bulimia’, and ‘Body Dissatisfaction’ are significantly higher in this group. However, there were non-significant differences between the AN-R group and the AN-A group in the other scales of EDI-3, confirming that is not correct to consider atypical AN as a ‘mild’ form of AN [7]. In line with literature, the ARFID group presents a lower frequency of typical ED symptoms compared to the AN groups [5, 46].

No differences between the three groups were detected for items: ‘Interpersonal Insecurity’, ‘Interoceptive Deficits’, ‘Emotional Dysregulation’, and ‘Maturity Fears’. These items, respectively, assess the discomfort in social situations, the confusion related to recognition and response of emotional states (“interoceptive awareness”), mood instability, and the fear to adhere to adult developmental expectations. Similar results have been reported in a recent study [35] using EDI-C in a sample of AN and ARFID children under 13 years of age. These results showed no difference between the groups on ‘Emotional Instability’, ‘Overeating’, and ‘Maturity Fears’, while higher scores were found in children with AN compared

to those with ARFID on ‘Drive for Thinness’ and reported ‘Lower Self-Esteem’.

Considering eating behaviors, the literature data recently confirmed that persistent undereating or fussy eating was associated with high AN risk in adolescence [47]. However, it is still not clear whether childhood eating behaviors are an early manifestation of a specific phenotype or whether the mechanisms underlying this continuity are more complex. This cross-sectional study is a first assessment of the similarities and differences between patient with ARFID and their possible future condition. The observations of this cross-sectional study need to be verified in a longitudinal study following the ARFID patients over time. Our results, however, suggest that restrictive eating behaviors share a psychopathological vulnerability, starting from an early age. For example, patients with ARFID show two critical items on EDI-3 (‘Fear of Maturity’ and ‘Interpersonal Insecurity’) compared to all the other items that remain below the threshold.

How these factors interact with each other and influence the developmental trajectories needs to be explored. Recently, it has been hypothesized that negative affectivity and internalizing symptoms play an important role in the development of AN [48]. We hope that future prospective and retrospective research will establish whether there is a “continuity spectrum” between internalizing symptoms of ARFID into AN or if they are two different age-related EDs. However, being able to highlight areas of greatest internal conflict such as fear of maturity or interpersonal insecurity for example, could make treatments begun at an earlier age more specific and modulated on patient’s needs.

The study has several limitations that deserve mention. First, the retrospective nature of this study and the use of self-administered questionnaires that are not specific to ARFID correlate and that could not capture the unique psychopathological profile. Second, it is not possible to generalize results for male patients, because most of our sample was female and for adult populations or adolescent outpatients or community sample. However, this is the first study that compares clinical and symptomatological features of AN-R, AN-A, and ARFID in adolescence, using a diagnostic interview and psychometric measures.

## What is already known on this subject?

Restrictive forms are the most common Eating Disorders in developmental age. 63% of children with food problems maintain moderate-to-severe malnutrition or migrate to Anorexia Nervosa in adolescence [1, 2].

## What does this study add?

Restrictive Eating Disorders share a common psychopathological vulnerability in developmental age. Being able to highlight these areas could make treatments early and modulated on patient's needs.

**Author contributions** The manuscript has been seen and reviewed by all authors and all authors have contributed to it in a meaningful way. VZ and SV: designed and executed the study and wrote the paper. AM and MC: collaborated with the design and writing of the paper. PP, AM, and MC: analyzed the data and wrote results. AET, IC, CM, GC, and MCC: collaborated in the writing and editing of the final manuscript.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** This study has been approved by the appropriate Ethics Committee (protocol number 1701\_OPBG\_2018) and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Specific Italian laws have been observed, too.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

## References

- Norris ML, Spettigue WJ, Katzman DK (2016) Update on eating disorders: current perspectives on avoidant/restrictive food intake disorder in children and youth. *Neuropsychiatr Dis Treat* 12:213–218. <https://doi.org/10.2147/NDT.S82538>
- Lucarelli L, Sechi C, Cimino S, Chatoor I (2018) Avoidant/restrictive food intake disorder: a longitudinal study of malnutrition and psychopathological risk factors from 2 to 11 years of age. *Front Psychol*. <https://doi.org/10.3389/fpsyg.2018.01608>
- APA (2013) American Psychiatric Association, 2013. Diagnostic and statistical manual of mental disorders (5th ed.), American Psychiatric Association
- Sawyer SM, Whitelaw M, Le Grange D et al (2016) Physical and psychological morbidity in adolescents with atypical anorexia nervosa. *Pediatrics*. <https://doi.org/10.1542/peds.2015-4080>
- Moskowitz L, Weiselberg E (2017) Anorexia nervosa/atypical anorexia nervosa. *Curr Probl Pediatr Adolesc Health Care* 47:70–84. <https://doi.org/10.1016/j.cppeds.2017.02.003>
- Garber AK, Cheng J, Accurso EC et al (2019) Weight loss and illness severity in adolescents with atypical anorexia nervosa. *Pediatrics*. <https://doi.org/10.1542/peds.2019-2339>
- Santonastaso P, Bosello R, Schiavone P et al (2009) Typical and atypical restrictive anorexia nervosa: weight history, body image, psychiatric symptoms, and response to outpatient treatment. *Int J Eat Disord* 42:464–470. <https://doi.org/10.1002/eat.20706>
- Bühren K, Schwarte R, Fluck F et al (2014) Comorbid psychiatric disorders in female adolescents with first-onset anorexia nervosa. *Eur Eat Disord Rev* 22:39–44. <https://doi.org/10.1002/erv.2254>
- Herpertz-Dahlmann B (2015) Adolescent eating disorders: update on definitions, symptomatology, epidemiology, and comorbidity. *Child Adolesc Psychiatr Clin N Am* 24:177–196
- Kaye WH, Wierenga CE, Bailer UF et al (2013) Does a shared neurobiology for foods and drugs of abuse contribute to extremes of food ingestion in anorexia and bulimia nervosa? *Biol Psychiatry* 73:836–842
- Koutek J, Kocourkova J, Dudova I (2016) Suicidal behavior and self-harm in girls with eating disorders. *Neuropsychiatr Dis Treat* 12:787–793. <https://doi.org/10.2147/NDT.S103015>
- Root TL, Pisetsky EM, Thornton L et al (2010) Patterns of co-morbidity of eating disorders and substance use in Swedish females. *Psychol Med* 40:105–115. <https://doi.org/10.1017/S0033291709005662>
- Swanson SA, Crow SJ, Le Grange D et al (2011) Prevalence and correlates of eating disorders in adolescents: results from the national comorbidity survey replication adolescent supplement. *Arch Gen Psychiatry* 68:714–723. <https://doi.org/10.1001/archgenpsychiatry.2011.22>
- Fisher MM, Rosen DS, Ornstein RM et al (2014) Characteristics of avoidant/restrictive food intake disorder in children and adolescents: a “new Disorder” in DSM-5. *J Adolesc Heal* 55:49–52. <https://doi.org/10.1016/j.jadohealth.2013.11.013>
- Forman SF, McKenzie N, Hehn R et al (2014) Predictors of outcome at 1 year in adolescents with DSM-5 restrictive eating disorders: report of the national eating disorders quality improvement collaborative. *J Adolesc Heal* 55:750–756. <https://doi.org/10.1016/j.jadohealth.2014.06.014>
- Ornstein RM, Nicely TA, Lane-Loney SE et al (2013) Prevalence and characteristics of the DSM-5 proposed avoidant/restrictive food intake disorder in a cohort of young eating disordered patients in day treatment. *J Adolesc Heal* 52:S38. <https://doi.org/10.1016/j.jadohealth.2012.10.092>
- Strandjord SE, Sieke EH, Richmond M, Rome ES (2015) Avoidant/restrictive food intake disorder: illness and hospital course in patients hospitalized for nutritional insufficiency. *J Adolesc Heal* 57:673–678. <https://doi.org/10.1016/j.jadohealth.2015.08.003>
- Haines J, Kleinman KP, Rifas-Shiman SL et al (2010) Examination of shared risk and protective factors for overweight and disordered eating among adolescents. *Arch Pediatr Adolesc Med* 164:336–343. <https://doi.org/10.1001/archpediatrics.2010.19>
- Keery H, Lemay-Russell S, Barnes TL et al (2019) Attributes of children and adolescents with avoidant/restrictive food intake disorder. *J Eat Disord*. <https://doi.org/10.1186/s40337-019-0261-3>
- Brigham KS, Manzo LD, Eddy KT, Thomas JJ (2018) Evaluation and treatment of avoidant/restrictive food intake disorder (ARFID) in adolescents. *Curr Pediatr Rep* 6:107–113. <https://doi.org/10.1007/s40124-018-0162-y>
- Feillet F, Bocquet A, Briend A et al (2019) Nutritional risks of ARFID (avoidant restrictive food intake disorders) and related behavior. *Arch Pediatr* 26:437–441
- Curtin C, Pagoto SL, Mick E (2013) The association between ADHD and eating disorders/pathology in adolescents: a systematic review. *Open J Epidemiol* 3:193–202. <https://doi.org/10.4236/ojepi.2013.34028>
- Pinhas L, Nicholls D, Crosby RD et al (2017) Classification of childhood onset eating disorders: a latent class analysis. *Int J Eat Disord* 50:657–664. <https://doi.org/10.1002/eat.22666>
- Ptacek R, Stefano GB, Weissenberger S et al (2016) Attention deficit hyperactivity disorder and disordered eating behaviors: links, risks, and challenges faced. *Neuropsychiatr Dis Treat* 12:571–579

25. Råstam M, Täljemark J, Tajnia A et al (2013) Eating problems and overlap with ADHD and autism spectrum disorders in a nationwide twin study of 9- and 12-year-old children. *Sci World J*. <https://doi.org/10.1155/2013/315429>
26. Nicely TA, Lane-Loney S, Masciulli E et al (2014) Prevalence and characteristics of avoidant/restrictive food intake disorder in a cohort of young patients in day treatment for eating disorders. *J Eat Disord*. <https://doi.org/10.1186/s40337-014-0021-3>
27. Zanna V, Castiglioni MC, Criscuolo M et al (2017) Day-hospital multifocal integrated treatment for anorexia nervosa in adolescents: a one-year follow-up. *J Child Fam Stud*. <https://doi.org/10.1007/s10826-017-0666-z>
28. Kaufman J, Birmaher B, Brent D et al (1997) Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): initial reliability and validity data. *J Am Acad Child Adolesc Psychiatry* 36:980–988. <https://doi.org/10.1097/00004583-199707000-00021>
29. Kovacs M, Camuffo M (1988) C.D.I. : Children's depression inventory : questionario di autovalutazione : manuale. Organizzazioni speciali
30. March JS, Parker JDA, Sullivan K et al (1997) The multidimensional anxiety scale for children (MASC): factor structure, reliability, and validity. *J Am Acad Child Adolesc Psychiatry* 36:554–565. <https://doi.org/10.1097/00004583-199704000-00019>
31. Achenbach TM, Rescorla LA (2007) Multicultural supplement to the manual for the ASEBA school-age forms and profiles. University of Vermont Research Center for Children, Youth, & Families, Burlington
32. Frigerio A, Montirosso R (2002) La valutazione su base empirica dei problemi emotivo-comportamentali in età evolutiva. *Infanz e Adolesc* 1:38–48
33. Garner DM (2004) Eating disorder inventory-3. Professional Manual, Lutz
34. Giannini M, Pannocchia L, Dalle Grave R, et al (2008) EDI-3 Eating Disorder Inventory-3: Manuale. Firenze
35. Lieberman M, Houser ME, Voyer AP et al (2019) Children with avoidant/restrictive food intake disorder and anorexia nervosa in a tertiary care pediatric eating disorder program: a comparative study. *Int J Eat Disord* 52:239–245. <https://doi.org/10.1002/eat.23027>
36. Mehta NM, Corkins MR, Lyman B et al (2013) Defining pediatric malnutrition. *J Parenter Enter Nutr* 37:460–481. <https://doi.org/10.1177/0148607113479972>
37. Bonafide CP, Brady PW, Keren R et al (2013) Development of heart and respiratory rate percentile curves for hospitalized children. *Pediatrics*. <https://doi.org/10.1542/peds.2012-2443>
38. Schaumberg K, Zerwas S, Goodman E et al (2019) Anxiety disorder symptoms at age 10 predict eating disorder symptoms and diagnoses in adolescence. *J Child Psychol Psychiatry Allied Discip* 60:686–696. <https://doi.org/10.1111/jcpp.12984>
39. Bleck J, DeBate RD (2013) Exploring the co-morbidity of attention-deficit/hyperactivity disorder with eating disorders and disordered eating behaviors in a nationally representative community-based sample. *Eat Behav* 14:390–393. <https://doi.org/10.1016/j.eatbeh.2013.05.009>
40. Grabarek C, Cooper S (2008) Graduate students' social and emotional functioning relative to characteristics of eating disorders. *J Gen Psychol* 135:425–451. <https://doi.org/10.3200/GENP.135.4.425-452>
41. Kaisari P, Dourish CT, Higgs S (2017) Attention Deficit Hyperactivity Disorder (ADHD) and disordered eating behaviour: a systematic review and a framework for future research. *Clin Psychol Rev* 53:109–121. <https://doi.org/10.1016/j.cpr.2017.03.002>
42. Welch E, Ghaderi A, Swenne I (2015) A comparison of clinical characteristics between adolescent males and females with eating disorders. *BMC Psychiatry* 15:45. <https://doi.org/10.1186/s12888-015-0419-8>
43. Biederman J, Faraone SV (2004) The Massachusetts General Hospital studies of gender influences on attention-deficit/hyperactivity disorder in youth and relatives. *Psychiatr Clin North Am* 27:225–232
44. Gudjonsson GH, Sigurdsson JF, Sigfusdottir ID, Young S (2014) A National Epidemiological Study of Offending and Its Relationship With ADHD Symptoms and Associated Risk Factors. *J Atten Disord* 18:3–13. <https://doi.org/10.1177/1087054712437584>
45. D'Agati E, Curatolo P, Mazzone L (2019) Comorbidity between ADHD and anxiety disorders across the lifespan. *Int J Psychiatry Clin Pract* 23:238–244
46. Zimmerman J, Fisher M (2017) Avoidant/restrictive food intake disorder (ARFID). *Curr Probl Pediatr Adolesc Health Care* 47:95–103. <https://doi.org/10.1016/j.cppeds.2017.02.005>
47. Herle M, De Stavola B, Hübel C et al (2019) A longitudinal study of eating behaviours in childhood and later eating disorder behaviours and diagnoses. *Br J Psychiatry*. <https://doi.org/10.1192/bjp.2019.174>
48. Monteleone AM, Mereu A, Cascino G et al (2019) Re-conceptualization of anorexia nervosa psychopathology: a network analysis study in adolescents with short duration of the illness. *Int J Eat Disord*. <https://doi.org/10.1002/eat.23137>

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