



ELSEVIER

JOURNAL OF
ADOLESCENT
HEALTH

www.jahonline.org

Original article

Early Course of Symptom Development in Anorexia Nervosa

Lisa M. Ranzenhofer, Ph.D.^{a,b,*}, Monica Jablonski^a, Lauren Davis^{a,c}, Jonathan Posner, M.D.^{a,b,d},
B. Timothy Walsh, M.D.^{a,b,1}, and Joanna E. Steinglass, M.D.^{a,b,1}

^a Department of Psychiatry, New York State Psychiatric Institute (NYSPI), New York, New York

^b Department of Psychiatry, Columbia University Irving Medical Center (CUIMC), New York, New York

^c Department of Psychology, Rutgers University, Highland Park, New Jersey

^d Department of Psychiatry & Behavioral Sciences, Duke University School of Medicine, Durham, North Carolina

Article history: Received February 15, 2022; Accepted June 13, 2022

Keywords: Anorexia nervosa; Eating disorder; Adolescence; Dieting; Loss-of-control eating; Course of illness; Risk factor

A B S T R A C T

Purpose: Anorexia nervosa (AN) commonly begins in adolescence; however, detailed knowledge of symptom trajectories, including their temporal sequence, is less well elucidated. The purpose of the present study is to describe the onset and duration of disordered eating behaviors prior to a diagnosis of AN, examine concordance between child and parent report, and examine the relationships between timing of symptom onset and illness severity.

Methods: Seventy-one adolescents (ages 12–18 years) and their parents were interviewed about dieting, restriction, loss of control/binge eating, purging, excessive/compulsive exercise, weight history, and amenorrhea. Body mass index percentiles were calculated, and adolescents completed the Eating Disorder Examination-Questionnaire.

Results: Restriction, being underweight, dieting, and excessive exercise were reported by most of the sample; purging, loss-of-control eating, and having been overweight were reported by less than a third. Dieting typically emerged first, on average around age 14; the remainder of behaviors tended to emerge between ages 14 and 14½; and average age of formal diagnosis was slightly over 15 years. Dyads had good agreement regarding presence and timing of all behaviors except for dieting, for which children reported about 6 months earlier onset/longer duration, compared to parents. Although older age at interview was associated with lower body mass index percentile and higher EDE-Q score, neither age of onset nor duration was associated with severity when controlling for current age.

Discussion: Teens and parents describe a similar sequence of behavior changes leading up to a diagnosis of AN that typically begins with dieting and occurs over an approximate 1- to 1½-year period. Querying teens and parents about eating behavior changes may aid in identification and early intervention in AN; adolescents with normal weight who engage in persistent dieting or restrictive eating may warrant more frequent weight monitoring.

© 2022 Society for Adolescent Health and Medicine. All rights reserved.

IMPLICATIONS AND CONTRIBUTION

Teenage girls with AN and their parents describe a similar course of development of behavioral symptoms, beginning with dieting and restriction of food intake. Findings suggest that it may be useful to query teens even of normal weight and to monitor more closely those who endorse these behaviors.

Conflicts of interest: J.E.S. receives royalties from UpToDate.

* Address correspondence to: Lisa M. Ranzenhofer, Ph.D., 1051 Riverside Drive, Suite 2200, New York, NY 10032.

E-mail address: lr2840@cumc.columbia.edu (L.M. Ranzenhofer).

¹ These authors contributed equally.

Anorexia nervosa (AN) is associated with significant medical [1] and psychiatric comorbidity [2,3] and with a mortality rate among the highest of any psychiatric illness [4]. AN typically begins during adolescence and is associated with a wide range of outcomes, including full or partial recovery, chronic illness, and

death [5]. Some studies have found that longer duration of illness is associated with poorer outcomes [6–9] suggesting that early intervention may increase the chances of recovery [10]. To facilitate early recognition of the development of AN and prompt intervention, detailed knowledge regarding the course of symptom evolution is needed.

Age of onset is often reported in published studies of AN but the method of ascertainment is frequently either not reported or assessed via a single question asking patients to report when the diagnosis was first made [8,11–13]. Individuals may respond variably to such inquiries. Some patients may describe disturbed eating for as long as they can remember, while others may date onset as when they first sought treatment, despite earlier manifestations of the illness. As noted by Broomfield, reports of age of onset may include when the parent first recalls their child's eating behavior changing, the point at which the family first noticed a change, or when the patient first received a diagnosis [6]. Other studies have attempted to apply systematic methods to determine age of onset, such as determining when weight loss began [14,15] or, using a structured diagnostic interview, when all criteria for a formal diagnosis were first met [16]. Few studies have attempted to systematically examine timing and sequence of the emergence of individual symptoms.

We developed a brief semistructured interview to assess the early course of symptom development in adolescents with AN, and, using this instrument, we obtained information from 71 adolescents and at least one parent of each adolescent. The aim of the present paper is to describe the onset of disordered eating behaviors and their duration prior to diagnosis, as well as associations among timing of symptoms and illness severity. We report the frequency and timing of seven key behavioral and physical symptoms and the concordance between child and parent report.

Method

Participants

Participants were adolescent females (ages 12–18 years) with AN participating in research at the Eating Disorders Research Unit at New York State Psychiatric Institute. Participants had either the restricting or binge eating/purging subtype of AN, diagnosed by the Eating Disorder Assessment-5 [17]. Exclusion criteria were concurrent substance use disorder or other disorder requiring specialized treatment; taking antipsychotic medication (antidepressants were not exclusionary); major medical illness; or acute suicidality. Participants were enrolled between April 2017 and August 2021. This study was approved by the Institutional Review Board; adolescents younger than 18 years signed written assent and parents signed informed consent; adolescents 18 years of age signed informed consent.

Procedures

Adolescents' height and weight were measured using a calibrated stadiometer and a Detecto Balance Beam Scale during an in-person screening day; after March 2020 the COVID-19 pandemic necessitated remote video platform screening and for these adolescents, height and weight were reported during a structured diagnostic interview via remote video platform ($n = 28$). Body mass index (BMI) percentile scores were calculated based on

Centers for Disease Control and Prevention growth charts [18]. Adolescents and at least one parent were interviewed separately either via a secure remote video platform or in person.

Measures

Age-of-onset interview. The semistructured, approximately 15-minute interview queried five salient eating disorder (ED) behaviors: dieting, restriction, loss-of-control (LOC) or binge eating, purging, and excessive exercise. In addition, participants and their parents were asked whether and when the child had been underweight or overweight, and the presence and timing of primary or secondary amenorrhea. Dieting was defined as “deliberately changing eating patterns in any way to influence your shape or weight,” and restriction as “deliberately cutting down on the amount of food that you are eating, in order to change your shape or weight.” LOC eating was defined as “feeling unable to stop eating or control what or how much you are eating,” and this was expanded upon if needed. Purging was defined as “making yourself vomit on purpose, taking diuretics (water pills) or laxatives, chewing/spitting out food, or any other strategy to compensate for calories eaten.” Excessive or compulsive exercise was defined as “Feeling like you must exercise, or you feel driven to do it. You might feel upset or anxious if you do not exercise or will exercise even if sick or injured. You might continue exercising, sometimes in secret, if parents or doctors have told you to stop.” Additionally, if the child was an athlete, she was asked, “Do you exercise more than teammates or more than is expected from coaches?” Primary amenorrhea was defined as no menarche; secondary amenorrhea was defined as a postmenarchal girl having missed her period for at least 3 months.

For each behavior and for being underweight or overweight, adolescents were asked if they had ever experienced it, when it *first occurred*, when it began to *interfere* with functioning, and whether there was a time when the behavior or weight status ceased after it first started. Parents were asked the same questions about their child. Questions were administered separately to the teen and parent by a research assistant in a semistructured interview format. After the interview was initially developed, minor modifications were made to improve clarity, including assessing timing in months and years, rather than rounding to the nearest year. If only a season was recalled (e.g., “it was in the spring”), the months were coded as follows: Summer = June; Fall = September; Winter = December; Spring = April. For coding purposes, the date was coded as the first of the month (i.e., MM/01/YYYY), unless the child or parent specified that the behavior emerged at the end of the month, in which case it was coded as MM/15/YYYY. The last 24 participants completed timeline follow-back questions at the beginning of the interview to assist participants in providing the most accurate recollections, including name of school, grade in school, major life events, activities, and treatment history, when relevant.

Eating disorder psychopathology. Eating disorder psychopathology was assessed using the Eating Disorder Examination-Questionnaire (EDE-Q) [19]. The EDE-Q has adequate test-retest reliability, internal consistency, and construct validity [20], and it is widely used and part of the NIH PhenX toolkit [21]. It yields a global score which is an average of subscales measuring eating concerns, shape concerns, weight concerns, and restraint.

Statistical analyses

The number and proportion of adolescents and parents reporting each behavior and symptom are reported. Descriptive statistics are presented, including percentiles, calculated based on weighted means, in EXPLORE in SPSS. Two statistical approaches were used to evaluate agreement between parent and child report for the dichotomous variables of *presence* (yes or no) for each symptom. Cohen's kappa statistic, widely used to assess inter-rater agreement for paired data, was used to assess the level of agreement between parent and child report for each behavior (yes vs. no) [22]. Because Cohen's kappa is reduced in populations with very high or low base rates [23], rates of agreement are also presented for descriptive purposes, as recommended [24]. For continuous variables such as age of onset, one-sample *t*-tests were used to determine whether the difference between parent and child report (i.e., parent-child) differed significantly from zero. Time to diagnosis was calculated as the duration between when a disordered behavior or symptom first emerged and when the child formally received the diagnosis of AN from a clinician. Total duration was calculated as the duration between when a disordered behavior or symptom first emerged and the date of the interview. Linear regressions were used to examine the relationship between chronological variables (age of onset of restriction, age of ED diagnosis, duration of restriction, duration of the ED) and illness severity, as indicated by lower BMI Z-scores and higher EDE-Q global scores. In the series of regressions, each child- or parent-reported age of onset or duration variable was the independent variable, and the severity parameter was the dependent variable. Age at interview was included as a covariate in all models. Variables included in linear regressions were examined for normality (skewness < 1, kurtosis < 3). Transformations were used to improve normality for variables with non-normal distributions. Variables with nonzero values were transformed using logarithmic transformation, and those including values of zero in the range were transformed using square root transformation. After transformation, outliers were converted to fall 1.5*interquartile range above the 75th or below the 25th percentile. All variables had normal distributions (skew ≤ 1, kurtosis ≤ 3) after this procedure. All analyses were conducted using SPSS version 28.0.

Results

Description of the sample

Seventy-one participants with AN participated in this study. Sixty-eight child interviews (3 children did not complete the interview) and 67 parent interviews (4 parents did not complete the interview) were conducted. Data from child-parent dyads were available for 64 participants. Participant demographic and clinical characteristics are presented in Table 1.

Presence of eating disorder symptoms

Restriction, being underweight, dieting, and excessive exercise were each reported by a large majority of the sample of patients with AN (Table 2). Purging, LOC eating, and having been overweight were reported by less than a third. The level of concordance between parent and child report was >75% for all behaviors and for histories of under- and overweight. Kappa statistics indicated substantial agreement between adolescent

Table 1

Demographic and clinical characteristics of 71 adolescents with AN

	Mean ± SD	Range
Age at interview (years)	15.9 ± 1.6	12.1–18.7
Race	13 (18.3%) Asian 15 (21.1%) Hispanic/Latinx 38 (53.5%) White 1 (1.4%) Mixed race 4 (5.6%) Missing or declined to report	
Body mass index percentile	7.0 ± 7.0	1–26
Eating Disorder Examination-Questionnaire (Global score)	3.4 ± 1.7	0–5.7

AN = anorexia nervosa; SD = standard deviation.

and parent for exercise, purging, and history of overweight; fair agreement for dieting and LOC/binge eating; and no agreement for restriction and being underweight, although the latter result is likely due to the high base rate of restriction and underweight in the sample.

Timing of ED symptoms

Average age of onset, time to diagnosis, and total duration for each disordered behavior or symptom, as well as differences between child and parent reports, are presented in Table 3 and Figure 1.

Age of onset. Dieting was typically the first symptom to emerge, slightly before age 14 years as reported by the child, and slightly over 14 years as reported by the parent. Most of the behaviors, including restriction, purging, excessive exercise, and underweight status, tended to emerge between ages 14 and 14½ years, and average age of formal diagnosis was slightly over 15 years. Notably, the order of symptom emergence was the same for child and parent report: dieting, restriction, being underweight, and excessive exercise (LOC/binge eating, purging, and overweight were excluded because of their low frequencies). Those who reported having a history of overweight (*n* = 13) reported the age of onset of overweight in late childhood/pre-adolescent developmental period, around age 10–11 years. The only significant difference between child and parent estimates of age of onset was in the onset of dieting, for which the child report indicated onset 5–6 months younger than the parent report (Table 3).

Time between symptom emergence and diagnosis. Dieting reported by the child was present for about a year and a half before

Table 2

Number and percent of children and parents who endorsed each behavior and weight outcome, including indices of agreement (% who agreed and kappa)

	Child (<i>n</i> = 68)	Parent (<i>n</i> = 67)	% Who agreed	Kappa ± SE, significance
Restriction	67 (98.5%)	65 (97.0%)	95.3%	−0.02 ± 0.02, <i>p</i> = .86
Underweight	67 (98.5%)	65 (97.0%)	95.3%	−0.02 ± 0.02, <i>p</i> = .86
Dieting	58 (85.3%)	54 (80.6%)	79.7%	0.26 ± 0.15, <i>p</i> = .03
Excessive exercise	47 (69.1%)	42 (62.7%)	84.1%	0.67 ± 0.10, <i>p</i> < .001
Purging	19 (27.9%)	15 (22.4%)	90.6%	0.75 ± 0.10, <i>p</i> < .001
LOC or binge eating	16 (23.5%)	7 (10.4%)	78.1%	0.25 ± 0.14, <i>p</i> = .03
Overweight	13 (19.1%)	13 (19.4%)	93.8%	0.81 ± 0.09, <i>p</i> < .001

LOC = loss of control; SE = standard error.

Table 3

Average age of onset and interval between onset and formal diagnosis for each behavior, weight status, and diagnosis for all children and parents who endorsed each symptom, as well as difference in parent-child report for dyads who both reported behavior, 1-sided *t*-test

	Child report (n = 68)			Parent report (n = 67)			Child-Parent (n = 59)		p value
	n	Mean ± SD	Range	n	Mean ± SD	Range	n	Mean ± SE	
Age of onset (years)									
Overweight	13	10.8 ± 2.6	6.0–15.0	13	11.2 ± 3.1	6.0–15.8	11	0.01 ± 0.87	.99
Dieting	58	13.9 ± 1.9	8.0–17.7	54	14.3 ± 1.8	8.0–17.5	47	–0.48 ± 0.18	.01
Restriction	67	14.4 ± 1.6	9.8–17.3	65	14.3 ± 1.9	7.1–17.3	61	0.05 ± 0.17	.8
LOC/binge eating	14	14.6 ± 1.9	11.9–18.0	7	13.1 ± 3.3	6.0–15.1	2	–0.05 ± 0.05	.5
Underweight	66 ^a	14.5 ± 1.8	9.1–18.0	65	14.6 ± 1.6	10.9–18.1	60	–0.02 ± 0.07	.8
Excessive exercise	46	14.6 ± 1.8	11.0–18.0	41	14.7 ± 1.8	10.2–18.0	35	–0.21 ± 0.16	.2
Purging	19	14.6 ± 1.7	11.0–18.0	14	14.1 ± 1.5	11.0–16.0	12	0.00 ± 0.23	.99
Diagnosis	68	15.2 ± 1.6	11.0–18.3	67	15.2 ± 1.6	11.0–18.5	64	0.01 ± 0.06	.9
Interval between symptom onset and formal diagnosis (years) ^b									
Dieting	58	1.4 ± 1.4	0.0–6.0	54	0.9 ± 1.2	–0.6 to 7.0	47	0.48 ± 0.15	<.01
LOC/binge eating	14	1.1 ± 1.6	–0.2 to 4.8	7	2.2 ± 4.2	–1.5 to 11.0	2	0.12 ± 0.03	.1
Restriction	67	0.9 ± 0.9	0.0–4.0	65	0.8 ± 1.4	–1.0 to 9.5	61	–0.03 ± 0.16	.8
Underweight	66	0.7 ± 1.5	–1.0 to 7.4	65	0.6 ± 1.1	–1.0 to 5.5	60	0.04 ± 0.08	.6
Excessive exercise	46	0.7 ± 0.9	–0.9 to 2.5	41	0.5 ± 0.6	–0.9 to 2.5	35	0.23 ± 0.15	.1
Purging	19	0.6 ± 1.4	–2.0 to 3.8	14	0.5 ± 1.7	–2.0 to 5.0	12	–0.08 ± 0.33	.8
Total duration (years) between symptom onset and age-of-onset interview ^c									
Dieting	58	2.1 ± 2.0	0.2–8.9	54	1.6 ± 1.7	0.2–8.9	47	0.49 ± 0.18	.01
LOC/binge eating	14	1.5 ± 1.7	0.1–4.9	7	2.8 ± 4.0	0.1–11.4	2	0.05 ± 0.05	.5
Restriction	67	1.5 ± 1.4	0.2–6.4	65	1.4 ± 1.6	0.2–9.5	61	–0.05 ± 0.17	.8
Underweight	66	1.4 ± 1.7	0.1–7.9	65	1.2 ± 1.2	0.1–5.5	60	0.02 ± 0.07	.8
Excessive exercise	46	1.5 ± 1.4	0.2–5.9	41	1.3 ± 1.2	0.1–5.9	35	0.21 ± 0.16	.2
Purging	19	1.7 ± 1.7	0.2–6.4	14	1.7 ± 1.5	0.2–5.4	12	0.00 ± 0.23	.99
Diagnosis	68	0.7 ± 0.9	0.0–4.9	67	0.6 ± 1.0	0.0–4.9	64	–0.01 ± 0.06	.9

Bolded values reflect $P < .05$ (significant difference between child and parent report).

LOC = loss of control; SD = standard deviation; SE = standard error.

^a n < that reported in Table 2 because child/parent reported presence/absence of the behavior (Y/N) but age of onset for the behavior is missing (i.e., the behavior was endorsed, but no age of onset was reported).

^b Excluded overweight and diagnosis.

^c Excluded overweight.

diagnosis was made. The 17 children who endorsed LOC eating reported that it also began over a year before the ED diagnosis. Children reported the onset of all other symptoms—restriction, purging, excessive exercise, and underweight 6–11 months before diagnosis. Parents reported onset of LOC eating 2.2 years prior to diagnosis, dieting and restriction 9–10 months before diagnosis, and the remainder of the behaviors—purging, excessive exercise, and underweight—about 6–7 months before diagnosis. With the exception of dieting, child- and parent-reported duration of each symptom prior to diagnosis did not differ. For dieting, children reported 6 months longer duration of dieting by the time of diagnosis, compared to that reported by parents (Table 3).

Total duration (time between symptom emergence and interview). At the time of interview, average duration of dieting, as reported by children, was 2.1 years, and, as reported by parents, was 1.6 years. On average, children reported that dieting had been present for 6 months longer than parents, and this was the only individual behavior for which the total reported duration differed between child and parent report (Table 3). At the time of interview, most other symptoms had been present around 1.5 years, and their duration did not differ by child versus parent report.

Illness severity

Body mass index percentile. Current age was significantly inversely associated with BMI percentile ($r = -0.26$, $p = .03$) so

that older children tended to have lower BMI percentiles. In regression analyses including current age, there were no significant associations between child- or parent-reported age of onset of restriction (p 's $\geq .4$) or child- or parent-reported age of onset of illness (p 's $\geq .3$) and BMI percentile. Similarly, controlling for current age, there were no significant associations between child- or parent-reported duration of restriction (p 's $\geq .2$) or duration of illness (p 's $\geq .3$) and BMI percentile.

Eating Disorder Examination-Questionnaire global score. Current age was also significantly associated with EDE-Q score ($r = 0.40$, $p = .001$) so that older children tended to have higher EDE-Q scores. In regression analyses including current age, there were no significant associations between child- or parent-reported age of onset of restriction (p 's $\geq .5$) or child- or parent-reported age of onset of illness (p 's $\geq .3$) and EDE-Q score. Similarly, controlling for current age, there were no significant associations between child- or parent-reported duration of restriction (p 's $\geq .4$) or duration of illness (p 's $\geq .1$) and EDE-Q score.

Discussion

Although early intervention is presumed to improve outcomes in AN, there is a relative dearth of information regarding temporal trajectories of behavior change and ED symptoms prior to diagnosis, making it difficult to know precisely when to intervene. Using a new brief assessment interview, we describe

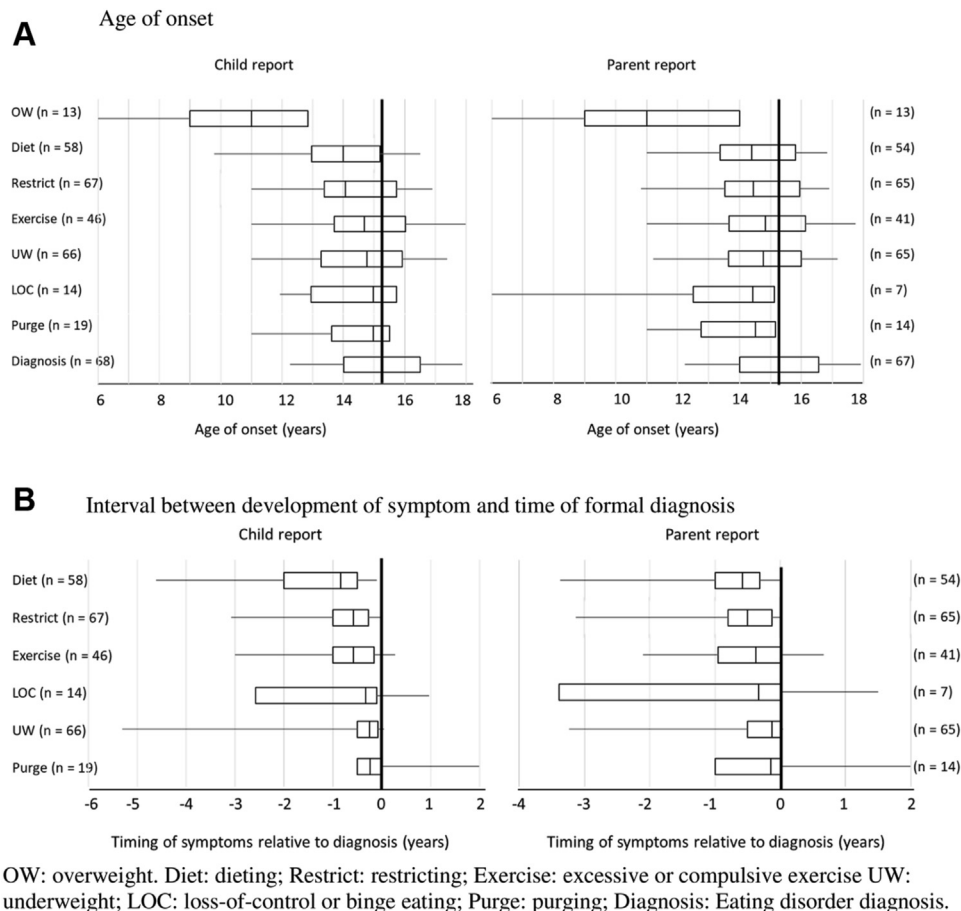


Figure 1. Chronologic emergence of eating disorder behaviors across the sample, including 5th, 25th, median, 75th, and 95th percentiles for each behavior. Box-and-whisker plots depicting 5th percentile (left-most whisker), 25th percentile (left box), median (line in center of box), 75th percentile (right box), and 95th percentile (right-most whisker) values for age of onset and duration prior to diagnosis of each behavior and having over- and underweight weight status. Vertical line indicates age at which formal diagnosis was made. (A) Average age of onset. (B) Average interval between development of symptom and time of formal diagnosis.

the time course of the development of disordered eating behaviors in a sample of female adolescents with AN. There are three key findings. First, regarding the chronology of AN symptoms, in this sample of adolescent girls ages 12–18 years diagnosed with AN, average age of onset of most symptoms was between 14 and 15 years. Second, there was generally good agreement between teens and parents regarding the presence and timing of most ED behaviors; the sole exception was that children reported the onset of dieting about 6 months earlier than parents. Third, older age at interview was associated with lower BMI percentile and higher EDE-Q global score. However, controlling for age, there were no associations between age of onset and duration with severity measures.

Timing of emergence of symptoms of anorexia nervosa

In the present study, the behaviors with the longest interval between onset and formal diagnosis were dieting and restriction. For most teens, dieting was the first symptom to emerge, typically followed by restriction and then changes in weight status and development of compensatory behaviors among a subset. The duration of ED behaviors before formal diagnosis was typically about a year, and some behaviors emerged after diagnosis.

Our findings that dieting and restriction were typically the first behaviors to emerge are consistent with that of Rosello et al. (2022) [25]. Notably, both children and parents were more likely to endorse restriction than dieting, which, in the present study, was defined as “deliberately cutting down on the amount of food that you are eating, in order to change your shape or weight”; in contrast, dieting was defined as “deliberately changing eating patterns in any way to influence your shape or weight.” Thus, reducing total amount of food was the distinguishing feature of restriction endorsed by nearly the entire sample (although for those endorsing both, dieting typically emerged first). Given the variable definitions of dieting and restriction in the literature, our findings suggest the possible utility of asking about both patterns—any changes designed to influence shape/weight and cutting down on total amount—in order to both identify the earliest possible indicators of risk of the development of AN and to capture intensifying behavior.

Parent-child agreement

Findings of the present study suggest fairly high rates of parent-child agreement regarding which behaviors the child experienced and the timing of their emergence. Although

restriction and being underweight did not show high agreement based on kappa values, this likely reflects kappa's limitations when sample rates are very high or low, in which cases concordance is likely a better indicator. A prior study of ED symptoms among 13- to 17-year-old children showed lower parent-child agreement [26]; however, in that study, youth completed one measure of symptoms (the Eating Attitudes Test - 26) and parents completed a different, parent-specific measure, and neither was a semistructured interview. It is also possible that the agreement rates in our specialized treatment setting may be higher than that which would be observed in settings where the adolescent's symptoms are more likely to be first detected, such as pediatric offices or in the community, before parents have been informed about the child's symptoms and have taken steps to establish specialty care. Indeed, in a large ($n > 2,000$) community-based sample, kappa values for parent-child agreement regarding ED symptoms were lower than those seen in the present study, and this was largely because adolescents were more likely to endorse behaviors compared with their parents [27]. Nonetheless, the high level of agreement between parents and children suggests that, in patients with an ED diagnosis, especially when multiple symptoms are queried, both parents and adolescents can be relied upon to provide useful reports. Finally, it is notable that, even though AN is often characterized as being ego-syntonic and by a denial by patients of the potential seriousness of the disorder, only one adolescent responded "no" when queried about restriction, defined as "deliberately cutting down on the overall amount you're eating, in order to change your shape or weight."

The only significant difference between parents' and children's reports regarding the timing of behaviors was with regards to dieting, for which children reported about 6 months earlier onset than parents. Although dieting is often shown to prospectively predict ED onset [28,29], over half of teens report dieting [30,31] while only a small subset develops an ED. It is possible that parents interpreted early changes in eating behavior as normative, leading to later identification, compared to teens' own reports. What distinguishes normative dieting efforts from dieting that evolves into maladaptive restrictive eating is not clear, but it is possible that an extended duration of dieting (rather than dieting for only a brief period) may be a marker of risk for intensifying restrictive eating, particularly for those with lower BMI at baseline, a risk factor for AN [28]. Research examining factors differentiating adolescents with normative dieting from those with more persistent and maladaptive eating behavior changes that characterize AN is needed to help parents and pediatricians intervene early. It is possible that dieting and weight loss efforts among teens of normal weight and with stable BMI trajectories should signal a need to ask about restriction to impact shape and weight and for closer monitoring of weight.

Associations between age of onset and duration and severity

The association between older age and lower BMI percentile and higher scores on the EDE-Q was not anticipated. It is possible that younger patients exhibit less body dissatisfaction or have less cognitive insight, explaining their lower scores on the EDE-Q. Younger children are thought to exhibit less shape and weight concerns [32]; only about half endorse body image

distortion [33]; and younger children are less likely to experience binge eating and purging [34]. All of these may result in lower EDE-Q global scores. With regards to the association between age and lower BMI percentile, it is possible that normative developmental changes in parents' involvement in their older (vs. younger) teens' lives (i.e., lower frequency of eating together, teen having more independence) may lead to older teens' BMI percentiles being lower by the time specialty care is sought. Although longer duration of illness is commonly associated with worse illness severity and recovery odds [8,35], neither duration of restriction nor the illness itself was related to severity within this age range (12–18 years) and range of illness duration (0–5 years). Indeed, in adults, only after 12–14 years duration of AN was there evidence of poorer outcome [8].

Strengths and limitations

Strengths of the study are the inclusion of both child and parent reports, and the structured interview methodology which allowed a careful, systematic probing of each queried behavior. Limitations of the study include that after March 2020; BMI calculations were based on self-reported height and weight data. A second limitation was the lack of in-depth assessments of the cognitive symptoms of AN, although as noted previously, intent of the behavior (i.e., to influence shape/weight) was embedded into questions pertaining to behavior. However, a result of this may be that the interview may not capture symptoms of youth who, either due to young age or lack of insight, demonstrate behavior that interferes with weight gain without acknowledging weight/shape as a motivation for the behavior. Addition of items to assess cognitive symptoms may enable the interview to capture more of the diagnostic criteria of EDs and elucidate temporal relationships between cognitive and behavioral symptoms. However, the focus of this interview was on behavior, and it is possible that cognitive symptoms may be more difficult to operationalize and assess. Third, the specific behaviors comprising dieting were not assessed in detail, precluding understanding of how dieting behavior in the present sample of teens who went on to develop AN compares with the upwards of 50% [30,36,37] of adolescents who also report dieting, a large proportion of whom do not develop an ED. Identifying similarities and differences between dieting that does/does not precede full-syndrome AN development has potential to further distinguish teens who may benefit from preventative intervention. Finally, the patient population was restricted to females aged 12–18 seeking care at a tertiary care center; our findings may not generalize to other populations.

Conclusions

When queried with a brief, semi-structured interview, teenage girls with AN and their parents describe a similar course of development of behavioral symptoms over approximately 12 months, beginning with dieting and restriction of food intake to influence shape or weight. Parents and teens reported a similar age of onset of most behaviors except for dieting, which teens reported occurred six months earlier than did parents. Findings suggest that it would be potentially useful to query teens even of normal weight and their parents about efforts to diet and to restrict food intake and to monitor more closely those who

endorse these behaviors. This practice in line with recommendations by the American Academy of Pediatrics in Bright Futures, 4th edition, “Evaluating the level of body satisfaction and practices the adolescent uses to maintain or reduce body weight (eg, dieting, binge eating, physical activity patterns) will help health care professionals recognize early symptoms of EDs that can develop with unhealthy weight control behaviors,” to which our findings lend support.

Acknowledgments

The authors thank the teens and parents who devoted time to participating in this study.

Funding Sources

This work was supported by the National Institute of Mental Health (R01 MH110445 to J.E.S. and J.P.; K24 MH113737 to J.E.S.; K23 MH121780 to L.M.R.) and the Hilda and Preston Davis Foundation.

References

- [1] Westmoreland P, Krantz MJ, Mehler PS. Medical complications of anorexia nervosa and bulimia. *Am J Med* 2016;129:30–7.
- [2] Hudson JL, Hiripi E, Pope HG Jr, Kessler RC. The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. *Biol Psychiatry* 2007;61:348–58.
- [3] Swanson SA, Crow SJ, Le Grange D, et al. Prevalence and correlates of eating disorders in adolescents. Results from the national comorbidity survey replication adolescent supplement. *Arch Gen Psychiatry* 2011;68:714–23.
- [4] Hoek HW. Incidence, prevalence and mortality of anorexia nervosa and other eating disorders. *Curr Opin Psychiatry* 2006;19:389–94.
- [5] Khalsa SS, Portnoff LC, McCurdy-McKinnon D, Feusner JD. What happens after treatment? A systematic review of relapse, remission, and recovery in anorexia nervosa. *J Eat Disord* 2017;5:20.
- [6] Broomfield C, Stedal K, Touyz S, Rhodes P. Labeling and defining severe and enduring anorexia nervosa: A systematic review and critical analysis. *Int J Eat Disord* 2017;50:611–23.
- [7] Errichello L, Iodice D, Bruzzese D, et al. Prognostic factors and outcome in anorexia nervosa: A follow-up study. *Eat Weight Disord* 2016;21:73–82.
- [8] Fernandez-Aranda F, Treasure J, Paslakis G, et al. The impact of duration of illness on treatment nonresponse and drop-out: Exploring the relevance of enduring eating disorder concept. *Eur Eat Disord Rev* 2021;29:499–513.
- [9] Glasofer DR, Muratore AF, Attia E, et al. Predictors of illness course and health maintenance following inpatient treatment among patients with anorexia nervosa. *J Eat Disord* 2020;8:69.
- [10] Treasure J, Russell G. The case for early intervention in anorexia nervosa: Theoretical exploration of maintaining factors. *Br J Psychiatry* 2011;199:5–7.
- [11] Davis L, Walsh BT, Schebendach J, et al. Habits are stronger with longer duration of illness and greater severity in anorexia nervosa. *Int J Eat Disord* 2020;53:413–9.
- [12] Takakura S, Aso CS, Toda K, et al. Physical and psychological aspects of anorexia nervosa based on duration of illness: A cross-sectional study. *Biopsychosoc Med* 2019;13:32.
- [13] Forman SF, Grodin LF, Graham DA, et al. An eleven site national quality improvement evaluation of adolescent medicine-based eating disorder programs: Predictors of weight outcomes at one year and risk adjustment analyses. *J Adolesc Health* 2011;49:594–600.
- [14] Jaite C, Buhren K, Dahmen B, et al. Clinical characteristics of inpatients with childhood vs. adolescent anorexia nervosa. *Nutrients* 2019;11:2593.
- [15] Keski-Rahkonen A, Raevuori A, Bulik CM, et al. Factors associated with recovery from anorexia nervosa: A population-based study. *Int J Eat Disord* 2014;47:117–23.
- [16] Grilo CM, Udo T. Examining the significance of age of onset in persons with lifetime anorexia nervosa: Comparing child, adolescent, and emerging adult onsets in nationally representative U.S. study. *Int J Eat Disord* 2021;54:1632–40.
- [17] Sysko R, Glasofer DR, Hildebrandt T, et al. The eating disorder assessment for DSM-5 (EDA-5): Development and validation of a structured interview for feeding and eating disorders. *Int J Eat Disord* 2015;48:452–63.
- [18] Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. *Adv Data* 2000;314:1–27.
- [19] Fairburn CG, Beglin SJ. Assessment of eating disorders: Interview or self-report questionnaire? *Int J Eat Disord* 1994;16:363–70.
- [20] Berg KC, Peterson CB, Frazier P, Crow SJ. Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: A systematic review of the literature. *Int J Eat Disord* 2012;45:428–38.
- [21] Hamilton CM, Strader LC, Pratt JG, et al. The PhenX toolkit: Get the most from your measures. *Am J Epidemiol* 2011;174:253–60.
- [22] Cohen J. A coefficient of agreement for nominal scales. *Educ Psychol Meas* 1960;20:37–46.
- [23] Morris R, MacNeela P, Scott A, et al. Ambiguities and conflicting results: The limitations of the kappa statistic in establishing the interrater reliability of the Irish nursing minimum data set for mental health: A discussion paper. *Int J Nurs Stud* 2008;45:645–7.
- [24] Hoehler FK. Bias and prevalence effects on kappa viewed in terms of sensitivity and specificity. *J Clin Epidemiol* 2000;53:499–503.
- [25] Rosello R, Gledhill J, Yi I, et al. Recognition and duration of illness in adolescent eating disorders: Parental perceptions of symptom onset. *Early Interv Psychiatry* 2022;16:854–61.
- [26] Laporta-Herrero I, Latorre P. Do parents perceive the abnormal eating attitudes of their adolescent children with anorexia nervosa? *Clin Child Psychol Psychiatry* 2020;25:5–15.
- [27] Bartholdy S, Allen K, Hodsoll J, et al. Identifying disordered eating behaviours in adolescents: How do parent and adolescent reports differ by sex and age? *Eur Child Adolesc Psychiatry* 2017;26:691–701.
- [28] Stice E, Gau JM, Rohde P, Shaw H. Risk factors that predict future onset of each DSM-5 eating disorder: Predictive specificity in high-risk adolescent females. *J Abnorm Psychol* 2017;126:38–51.
- [29] Pearson CM, Miller J, Ackard DM, et al. Stability and change in patterns of eating disorder symptoms from adolescence to young adulthood. *Int J Eat Disord* 2017;50:748–57.
- [30] Neumark-Sztainer D, Wall M, Larson NI, et al. Dieting and disordered eating behaviors from adolescence to young adulthood: Findings from a 10-year longitudinal study. *J Am Diet Assoc* 2011;111:1004–11.
- [31] Yoon C, Mason SM, Hooper L, et al. Disordered eating behaviors and 15-year trajectories in body mass index: Findings from project eating and activity in teens and young adults (EAT). *J Adolesc Health* 2020;66:181–8.
- [32] American Psychiatric Association. DSM-5 task force. Diagnostic and statistical manual of mental disorders: DSM-5. 5th ed. Virginia: American Psychiatric Association; 2013.
- [33] Pinhas L, Morris A, Crosby RD, Katzman DK. Incidence and age-specific presentation of restrictive eating disorders in children: A Canadian paediatric surveillance program study. *Arch Pediatr Adolesc Med* 2011;165:895–9.
- [34] Herpertz-Dahlmann B, Dahmen B. Children in need-diagnoses, epidemiology, treatment and outcome of early onset anorexia nervosa. *Nutrients* 2019;11:1932.
- [35] Wild B, Friederich HC, Zipfel S, et al. Predictors of outcomes in outpatients with anorexia nervosa - results from the ANTOP study. *Psychiatry Res* 2016;244:45–50.
- [36] Boutelle K, Neumark-Sztainer D, Story M, Resnick M. Weight control behaviors among obese, overweight, and nonoverweight adolescents. *J Pediatr Psychol* 2002;27:531–40.
- [37] Solmi F, Sharpe PhD H, Gage SH, et al. Changes in the prevalence and correlates of weight-control behaviors and weight perception in adolescents in the UK, 1986–2015. *JAMA Pediatr* 2021;175:267–75.