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Frequency and Patterns of Eating Disorder Symptoms in Early Adolescence

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A B S T R A C T

Purpose: There are still uncertainties about manifestations of early adolescent eating disorders (ED) and their effects. We aimed to determine the prevalence of ED symptoms in early adolescence, derive symptoms dimensions, and determine their effects on social and psychological outcomes and subsequent body mass index (BMI).

Methods: Data on 7,082 adolescents aged 13 years from the Avon Longitudinal Study of Parents and Children were obtained on ED symptoms, resulting impairment and family burden and emotional and behavioral disorders using the parental version of the Developmental and Well-being Assessment. Exploratory structural equation models were used to derive ED symptoms dimensions separately by sex and to relate these to contemporary outcomes (impairment, burden, and emotional and behavioral disorders) and a distal outcome (objective BMI at age 15 years).

Results: Extreme levels of fear of weight gain, avoidance of fattening foods, and distress about weight and shape were common among girls (11%). Three ED symptoms dimensions were identified: bingeing/overeating, weight/shape concern and weight-control behaviors, and food restriction. Bingeing/overeating was strongly associated with higher functional impairment, family burden, and comorbid psychopathology. Bingeing/overeating and weight/shape concern and weight-control behaviors predicted higher BMI 2 years later, whereas food restriction predicted lower BMI. These effects did not change when BMI at age 13 years was included in the model.

Conclusions: Eating disorder cognitions are common among young teenage girls. Eating disorder symptoms have adverse cross-sectional and distal consequences, in particular on increasing body weight 2 years later. These findings have important implications for early identification of adolescents engaging in ED behaviors and for obesity prevention.

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IMPLICATIONS AND CONTRIBUTION

Eating disorder behaviors and cognitions are common in early adolescence and are negatively associated with a series of social and psychological outcomes. Most important, they predict weight status 2 years later. Public health efforts for early identification and prevention of eating disorders are therefore crucial.

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There is increasing evidence that eating disorders (ED) might be more common than previously thought [1,2]. Eating disorders have a peak of onset between ages 15 and 19 years [3]; in a recent study, we showed that in adolescent and young adult United States girls, ED predicted overweight and obesity as well as psychopathology and substance use [1]. Few studies have investigated the short- and long-term effects of adolescent ED behaviors on social, psychological, and physical health.

Challenges to clarification of the epidemiology and impact of adolescent ED behaviors include remaining uncertainties about classification and whether current diagnostic systems apply to adolescents [4], as well as little knowledge about how ED behaviors present in early adolescence (13–14 years) in community samples. Understanding ED behaviors and cognitions at this developmental stage and how they affect a series of outcomes might prove fruitful for increased knowledge of the early constellation of symptoms that index prodromal ED or at-risk states, and to aid in prevention.

To our knowledge, no population-based studies outside the United States have investigated associations between a wide range of ED symptoms in early adolescence and social, physical, and psychological outcomes. Moreover, few longitudinal population-based studies in the world lend themselves to a similar investigation.

This study aimed first to investigate ED symptoms in girls and boys from a population-based study in the United Kingdom (UK), the Avon Longitudinal Study of Parents and Children (ALSPAC) and how they clustered into observable dimensions (latent variables) at age 13 years. Second, we attempted to determine whether identified ED symptoms dimensions would be associated with contemporary impairment, family burden, and emotional and behavioral disorders, and predict body mass index (BMI) 2 years later.

Because of the availability of statistical techniques allowing obtaining latent factors (dimensions) from observed data and jointly modeling a predictive model, we set out to use this framework to achieve these aims.

Methods

Participants

The Avon Longitudinal Study of Parents and Children is a longitudinal, population-based study of 14,541 women and their children, who were prospectively enrolled [5,6]. All pregnant women in the geographical area of Avon, UK, who were expected to deliver their baby between April 1, 1991 and December 31, 1992 were invited to take part in the study. All women gave informed and written consent. At 1 year, 13,988 children were alive. Questionnaires were sent to parents of 10,135 children still enrolled in the cohort at age 13 years and 479 children who were enrolled in ALSPAC in a second phase of the study (for details, see [6]). Questionnaires were returned by 7,165 parents (67.5%).

Mean age at data collection was 13.1 years; 99% of adolescents were younger than 13.9 years of age at questionnaire completion. Adolescents whose data were collected at >14.5 years ($N = 7$) were excluded.

A total of 76 twin-pairs provided data; one twin per pair was randomly excluded from the current analyses. The total study size was 7,082 adolescents.

Eating disorders symptoms

We collected information from questions on ED behaviors and cognitions from the ED section of the Developmental and Well-being

Assessment (DAWBA), a semistructured interview that generates a range of psychiatric diagnoses in children and adolescents based on the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV) [7] and *International Statistical Classification of Diseases and Related Health Problems*, 10th revision (ICD-10) [8] criteria. The DAWBA has a specific ED section of questions designed to obtain DSM-IV and ICD-10 diagnoses of anorexia nervosa, bulimia nervosa and eating disorders not otherwise specified for epidemiological studies. A questionnaire version of the ED-DAWBA was used for this study, which was composed of 28 questions on ED behaviors and cognitions, four on impairment on the adolescent life as a result of ED symptoms (detailed below), and one on burden on the family or the parent caused by the symptoms [9].

Cognitions investigated were fear about weight gain and being upset or distressed about weight and shape. Behaviors investigated were avoidance of fattening foods, food restriction (a summary variable incorporating eating less at mealtimes, skipping meals, and going without food for long periods of time [i.e., all day or most of the day]), exercising for weight loss, and purging (self-induced vomiting and use of laxatives or other medicines for weight loss).

Parents were asked to report about the child's bingeing (losing control over eating and eating a large amount of food in a short time) in terms of monthly, weekly, or twice a week or more; questions on compensatory behaviors allowed answers of "no," "a little," "a lot," and "tried but not allowed" (the latter category was recoded as "a little," with intention being conceptualized as indicating presence of the behavior).

Contemporary outcomes

Social impairment and family burden of eating disorder symptoms. Impairment was derived from the ED-DAWBA questions asking "How much do you think the eating patterns/concerns about weight and shape have interfered with: how well he/she gets on with the rest of the family? making and keeping friends? learning or class work? hobbies, sports or other leisure activities?" All stems had a four-level Likert response ("not at all," "a little," "quite a lot," and "a great deal"). A categorical summary variable was generated from the answers to these questions: "no impairment" (no impairment reported on any aspect of the adolescent's life) or "high" impairment (any question answered as "a lot" or "a great deal"); any other combination was coded as "some impairment."

Burden to the family was derived from the question "Have the eating patterns/concerns about weight and shape put a burden on you or your family?" The question had a four-level Likert response ("not at all," "a little," "quite a lot," or "a great deal"); we combined the "quite a lot" and "a great deal" categories.

Psychopathology: emotional and behavioral disorders. At the same time, parents completed a questionnaire version of the DAWBA for all other mental health disorders. As described above, the DAWBA is a validated instrument to assess psychopathology in children and adolescents [10,11]. Variables indicating presence of any DSM-IV or ICD-10 emotional and behavioral disorder were obtained from the DAWBA using computer algorithms (as detailed in [9]). These diagnoses have been shown to be valid albeit likely to underestimate psychopathology [9]. Computer-generated diagnoses using the parent-rated DAWBA have been shown to have

moderate to high agreement with clinician-rated multi-informant emotional and behavioral disorders diagnoses [9].

Distal outcome: body mass index at age 15 years

All children still enrolled in the study were measured at the ALSPAC base at age 15 years. Data were available on 4,467 adolescents included in this study (63% of the total). Not attending was predicted by sociodemographic characteristics such as ethnicity and family income (for details, see [6]). Mean age of assessment was 15.3 years, with 90% of adolescents aged ≤ 15.9 years at assessment. There was no overlap between this assessment and the age at assessment of ED symptoms. Age- and gender-adjusted BMI z-scores (using UK references) were obtained from the Stata user-defined program “Z-anthro” [11,12].

Body mass index at age 13 years

Objective weight and height measured at the ALSPAC base were also available on 5,481 adolescents at age 13 years. Age- and gender-adjusted BMI z-scores were obtained as above.

Sociodemographic data

Sociodemographic data were obtained from parents during pregnancy (maternal age at enrolment, parity, maternal highest education, and parental social class), at birth (birth weight and gender), or throughout childhood (child ethnicity and family income).

Statistical analyses

All analyses were run separately for boys and girls because of expected differences in behaviors and correlates.

Exploratory factor analysis. To identify latent dimensions of ED symptoms, we selected all questions from the ED-DAWBA about ED cognitions and behaviors to conduct an exploratory factor analysis (EFA), using a Geomin rotation (oblique). We selected factors with a corresponding eigenvalue > 1 .

Exploratory structural equation modeling. Exploratory structural equation modeling (ESEM) is a method that combines features of unrestrictive measurement models (EFA) with restrictive measurement models (confirmatory factors analysis [CFA]) [13]. Exploratory structural equation modeling allows part of the structural model to be exploratory, in the sense that no constraints are imposed on whether factor loadings that capture the association between latent factors and manifest indicators should be fixed at 0, akin to CFA, whereas latent factors are allowed to influence all manifest indicators according to a predefined number of latent factors. Exploratory structural equation modeling therefore combines the flexibility of EFA with statistical properties that were previously only available in restrictive CFA models [13]. Similarly to traditional EFA and CFA, ESEM results in the derivation of latent factors from observed variables, but crucially it allows the selected measurement model to be included jointly—or in two-step approaches—in predictive models where external variables are modeled as outcomes of the ESEM measurement structure [14,15].

We used ESEM to investigate the associations between ED symptoms dimensions and contemporary correlates and a distal outcome.

All models were fitted using Mplus version 6.1 [16] by weighted least-squares mean and variance adjusted estimators.

Contemporary and distal outcomes were jointly modeled; paths from correlates (psychopathology, impact, and burden) to the distal outcome (BMI at 15 years) were constrained to zero to estimate the effect of the latent factors on each outcome separately but within the same model.

All models were estimated separately by sex.

We assessed model fit using the root mean square of approximation (RMSEA, a parsimony adjusted index) and the Tucker-Lewis Index (TLI).

Attrition

Complete data on ED symptoms and contemporary outcomes were available on 2,990 girls and 3,006 boys.

Complete data on ED symptoms, contemporary outcomes, distal outcome, and sociodemographic covariates were available on 1,856 boys and 1,997 girls, respectively, 86% and 87% of those with BMI data at age 15 years.

Predictors for missing data were maternal age, parity, maternal education, parental social class (for girls and boys), and child ethnicity (for boys only).

Analyses were carried out using incomplete records (2,990 girls and 3,006 boys), including all predictors of missingness in the ESEM models, under the missing at random assumption.

Sensitivity analyses compared these results with those obtained on the restricted datasets with complete information.

The study was approved by the Institute of Psychiatry Ethics committee (Reference 110/02), the ALSPAC Law and Ethics Committee, and the local research ethics committees.

Results

Sample characteristics

The available sample had similar numbers of boys (49.9%) and girls (50.1%). Boys and girls were comparable on all sociodemographic and childhood characteristics. As expected, boys had a slightly higher birth weight compared with girls (Table 1).

Emotional disorders at age 13 years were similarly prevalent across genders; behavioral disorders were more common in boys.

Eating disorders behaviors and cognitions

Eating disorder behaviors and cognitions overall were more common in girls. At age 13 years, 63.2% of girls were described as being afraid of gaining weight or getting fat and 11.5% as being extremely afraid or terrified of gaining weight or becoming fat; percentages were lower among boys (Table 2).

Being upset or distressed about weight and shape was reported at a high level (a lot) for 4.9% of girls and 2.4% of boys, with a positive association with female gender (Table 2).

In relation to ED behaviors, more girls than boys were described as engaging in fat-food avoidance. Food restriction was reported at a high level (a lot) in 2.4% of girls and 1.8% of boys, with a significant gender difference. Exercise for weight loss was similarly prevalent in boys and girls; however, more boys than girls were engaging in high-level exercise for weight loss (4.8% vs. 3.8%) (Table 2).

Purging (self-induced vomiting and use of laxatives for weight loss) was rare: seven girls (.23%) and five boys (.16%).

Table 1
Sample characteristics

	Females (N = 3,543)	Males (N = 3,528)
Ethnicity: Caucasian	3,124 (96.2%)	3,121 (96.5%)
Lowest parental social class: Non-manual	2,395 (83.9%)	2,439 (85.4%)
Maternal parity: multiparas	1,730 (52.7%)	1,727 (52.3%)
Maternal education: A-level or university degree	1,457 (44.3%)	1,440 (43.6%)
Maternal age at delivery, mean (SD)	29.0 (4.5)	29.3 (4.6)
Birth weight, mean (SD)	3,376 (504)	3,483 (554)
Mean age at assessment, months (SD)	157.9 (2.0)	157.9 (2.1)
Any DSM-IV or ICD-10 emotional disorder at age 13 years	60 (1.9%)	62 (2.0%)
Any DSM-IV or ICD-10 behavioral disorder at age 13 years	90 (2.9%)	122 (4.0%)
BMI at age 15 years, mean (SD) ^a	21.7 (3.6)	21.0 (3.3)

BMI = body mass index; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4th edition; ICD-10 = International Statistical Classification of Diseases and Related Health Problems, 10th revision; SD = standard deviation.

^a Data on BMI at age 15 years were available on 2,162 boys and 2,305 girls.

Bingeing was present at a similar level among girls and boys: bingeing once a week or more occurred in 1.2% of boys and .8% of girls (Table 2).

Exploratory factor analysis

Items from the ED-DAWBA were included in an EFA for boys and girls separately. Three factors with eigenvalues >1 were identified. Item loadings on these factors suggested gender differences. One item was extremely rare among boys, did not load on any factors, and was excluded from later analyses in boys (“Has your child ever deliberately made him/herself sick?”).

We named the three latent factors identified: binge eating/overeating, weight and shape concern with weight control behaviors (WCB), and food restriction.

Exploratory structural equation modeling

Given results from the EFA, three latent factors were included in gender-stratified ESEM analyses. As shown in Figures 1 and 2,

which illustrate details of the latent factors specification of the two ESEMs, all items loaded highly on specific factors ($p < .001$), although with slightly different loadings for boys and girls. Fit indices indicated very good fit of the models (in girls, RMSEA = .026, TLI = .96; in boys, RMSEA = .025, TLI = .97).

There was a moderate correlation between factors, with gender differences (i.e. stronger correlations) in boys. Bingeing/overeating was correlated with weight and shape concern and WCB (.53 in girls and .58 in boys) and with food restriction (.37 in girls and .54 in boys). Weight and shape concern and WCB were moderately correlated with food restriction in boys (.59) but only marginally in girls (.26).

Contemporary outcomes

Table 3 shows the association between ED symptoms dimensions identified and contemporary outcomes.

Girls. Bingeing/overeating was associated with impairment and burden; the estimated coefficients implied that a 1–standard deviation (SD) score increase in bingeing/overeating would increase the predicted probability of having impairment by 47% and the predicted probability of burden by 60%.

Bingeing/overeating was associated with both emotional disorders and behavioral disorders (Table 3).

Weight and shape concern and WCB were associated with burden to parents and with impairment, but not with emotional or behavioral disorders. Food restriction was associated with burden to parents and behavioral disorders (Table 3).

Boys. Bingeing/overeating was significantly associated with impairment and burden to parents; the estimated coefficients implied that for a 1-SD increase in the score for bingeing/overeating, the predicted probability of impairment increased by 47% and the predicted probability of family burden increased by 61%.

As with girls, bingeing/overeating was associated with both emotional disorders and behavioral disorders (Table 3).

Weight and shape concern and WCB were associated with impairment but not burden; they were not associated with

Table 2
Prevalence of eating disorder behaviors in girls and boys and gender comparisons from ordinal logistic regression

	Girls				Boys				Odds ratio (95% confidence interval) ^a
	N	No	A little	A lot/it terrifies her	N	No	A little	A Lot/It terrifies him	
Afraid of gaining weight or getting fat	3,473	1,278 (36.8%)	1,795 (51.7%)	400 (11.5%)	3,471	2,111 (60.8%)	1,197 (34.5%)	162 (4.7%)	2.2 (2.0–2.4)*
Upset/distressed about weight and shape	3,413	2,265 (66.4%)	A little 979 (28.7%)	A lot 169 (4.9%)	3,387	2,667 (78.7%)	A little 638 (18.8%)	A lot 82 (2.4%)	2.6 (1.5–4.5)*
Eating disorder behaviors		No	A little	A lot		No	A little	A lot	
Avoids fattening foods	3,501	1,653 (47.2%)	1,654 (47.2%)	194 (5.5%)	3,484	2,065 (59.0%)	1,288 (37.0%)	140 (4.0%)	1.6 (1.4–1.7)*
Food restriction in past 3 months	3,476	2,591 (75.5%)	802 (23.1%)	83 (2.4%)	3,483	2,980 (85.6%)	441 (12.7%)	62 (1.8%)	2.1 (1.8–2.3)*
Exercise for weight loss in past 3 months	3,486	2,530 (72.6%)	822 (23.6%)	134 (3.8%)	3,474	2,682 (77.2%)	625 (18.0%)	167 (4.8%)	1.2 (1.1–1.4)*
Purging in past 3 months	3,476	3,475 (99.8%)	6 (.2%)	1 (.03%)	3,466	3,461 (99.9%)	3 (.1%)	2 (.06%)	1.4 (1.4–4.4)
		No	Occasionally	Once a week or more		No	Occasionally	Once a week or more	
Bingeing in past 3 months	3,505	3,342 (95.3%)	134 (3.8%)	29 (.8%)	3,496	3,319 (95.0%)	134 (3.8%)	43 (1.2%)	.8 (.5–1.2)

^a Girls versus boys.

* $p < .0001$.

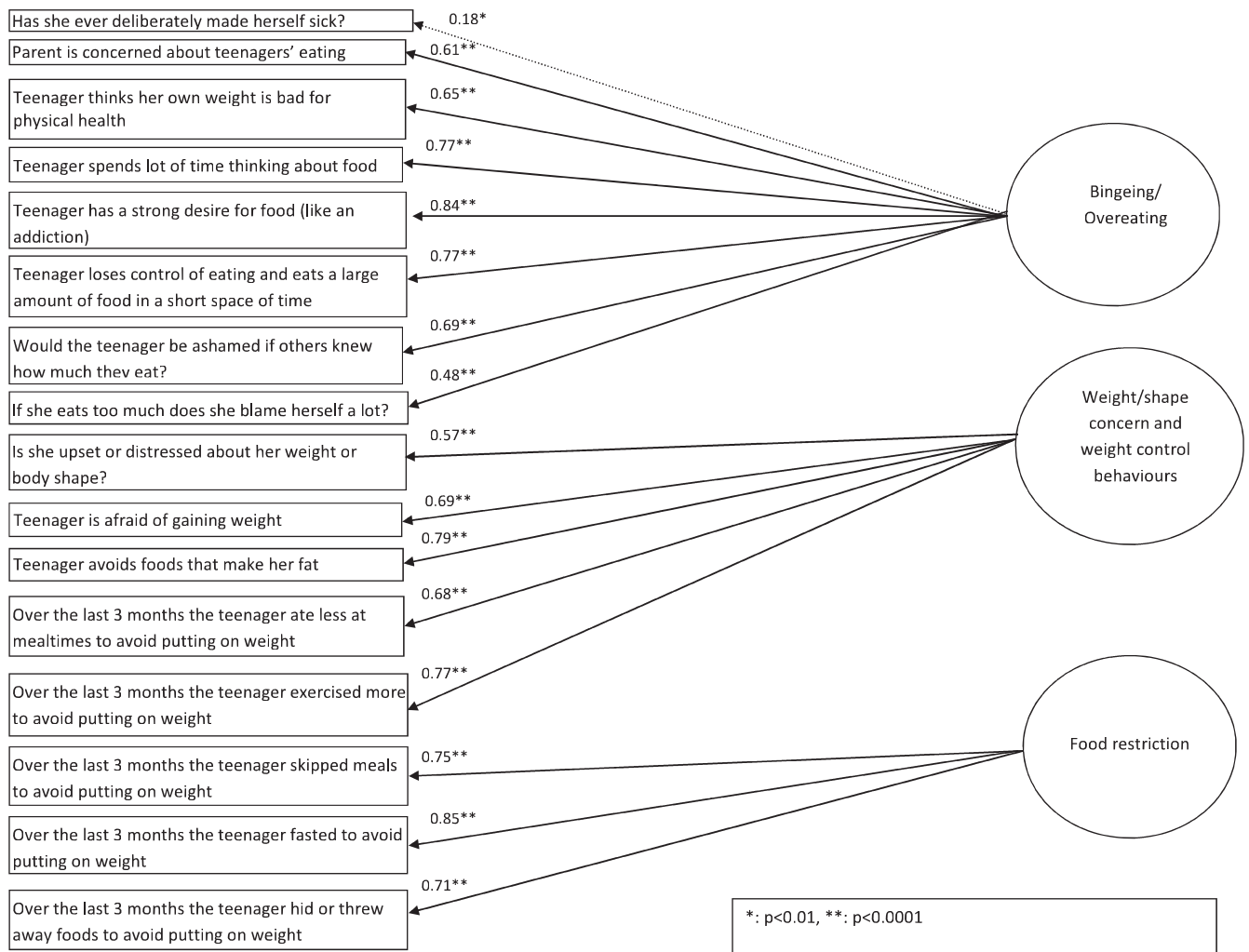


Figure 1. Girls (N = 2,990).

emotional disorders and were negatively associated with behavioral disorders (Table 3).

Food restriction in boys was associated with all four contemporary outcomes (Table 3).

Confounders included in the models (maternal age at enrolment, maternal education, parity, and parental social class) showed associations only with some dimensions. Low parental social class was associated with higher bingeing/overeating scores in girls (standardized coefficient, .22; $p = .006$) and lower food restriction scores in boys (standardized coefficient, $-.21$; $p = .04$). In boys only, higher maternal age and maternal primiparity were associated with higher weight and shape concern and WCB scores, respectively (standardized coefficients, .014; $p = .02$; and $-.13$; $p = .008$); and Caucasian ethnicity with higher food restriction (standardized coefficient, .60; $p < .0001$).

Distal outcome: body mass index at age 15 years

Bingeing/overeating in girls was strongly associated with higher BMI z-scores at 15 years of age i.e., 1-SD increase in the bingeing/overeating score corresponded to an expected .24

increase in BMI z-score. A similar strong association was seen in boys.

Weight/shape concern and WCB were also associated with higher BMI z-score at age 15 years across genders (Table 3).

The food restriction dimension, on the other hand, predicted a lower BMI z-score in girls and boys. In girls, 1-SD increase in the food restriction score corresponded to an expected .15 decrease in BMI z-score 2 years later; in boys, it corresponded to a .24 decrease (Table 3).

Body mass index z-score at 15 years of age was associated with younger maternal age (standardized coefficient, $-.01$; $p = .02$) and lower parental social class (standardized coefficient for manual vs. non-manual, .16; $p = .04$) in boys, and younger maternal age (standardized coefficient, $-.02$; $p = .007$) in girls.

To determine whether contemporary associations with BMI at age 13 years explained the associations found with BMI at age 15 years, we reran all ESEM models by including a direct path from the ED clusters to BMI at age 13 years and allowing BMI at age 13 years and BMI at age 15 years to be correlated. Although BMI at age 13 years was associated with all three ED clusters (positively with bingeing/overeating and weight and shape

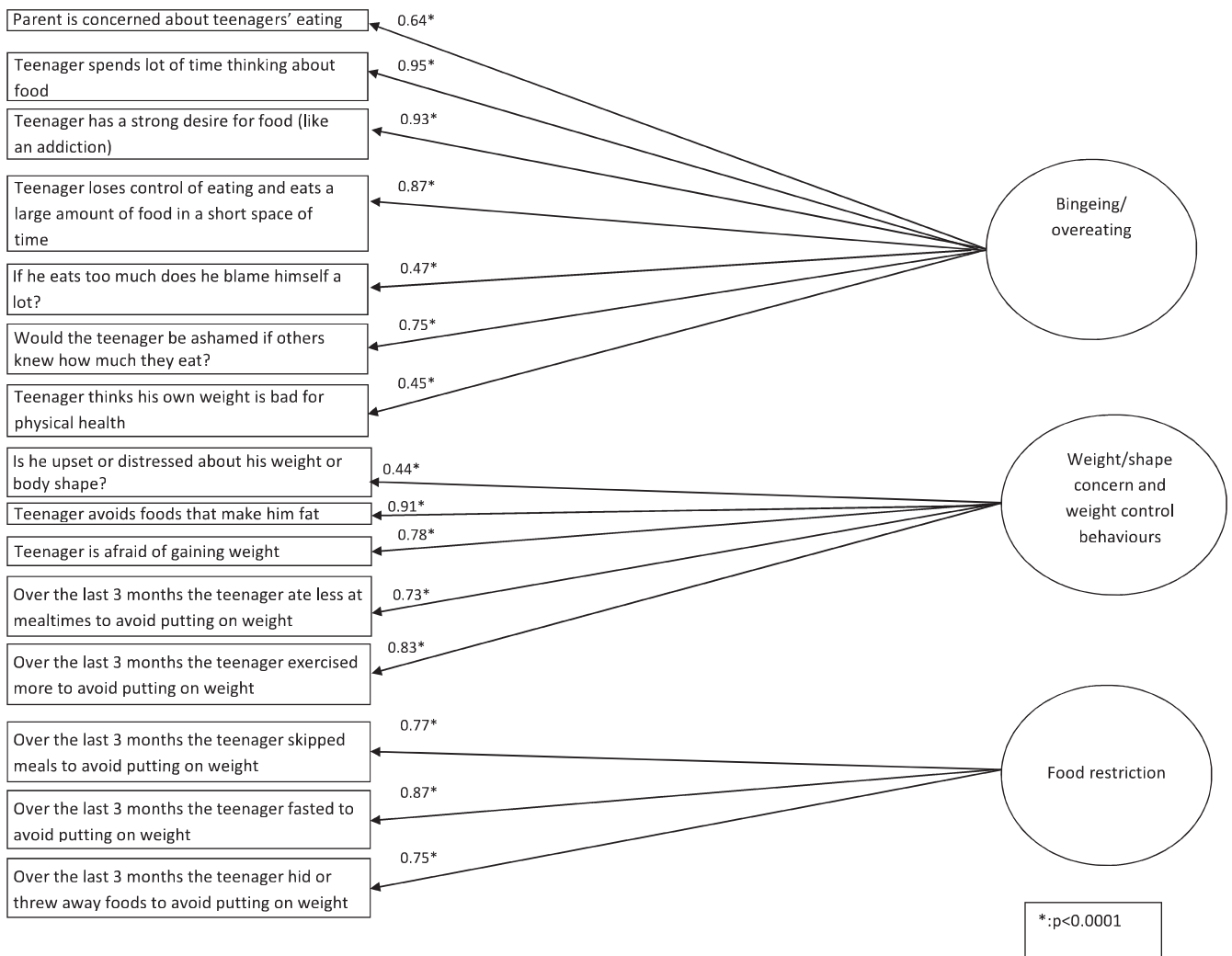


Figure 2. Boys (N = 3,006).

concern and weight control behaviors and negatively with food restriction), adding these paths made no difference to the results shown in Table 3.

We also performed a sensitivity analysis by including only complete records in the ESEM; however, no substantial differences in factor loadings or in the associations with contemporary and distal variables were apparent.

Discussion

This study used novel methodology to identify ED symptoms dimensions at age 13 years, while simultaneously determining their relationship with contemporary social (impairment and family burden), psychological (presence of an emotional or behavioral disorder), and distal physical (BMI z-score 2 years later) outcome in a community-based longitudinal sample. Three ED symptom dimensions were identified: bingeing/overeating, weight and shape concern and WCB, and food restriction. Different associations were identified among the three dimension and studied outcomes. Dimensions characterized by bingeing and weight and shape concern and WCB predicted later

high BMI for boys and girls. Food restriction, on the other hand, predicted lower BMI 2 years later. Bingeing/overeating was associated with emotional and behavioral disorders across genders. Social impairment was associated with bingeing/overeating and weight and shape concern and WCB across genders, but food restriction in boys only. Family burden was associated with all ED symptom dimensions.

Eating disorder symptoms dimensions at age 13 years

Although the ED symptoms dimensions identified showed moderate correlations (especially among boys), they were distinct. Largely, these might reflect broader early ED phenotypes indexing risk for clinical disorders. Bingeing/overeating did not have a compensatory behavior component, and had similarities to binge eating disorder: Weight and shape concern and WCB included both weight and shape concern, fear of weight gain, avoidance of fattening foods, and compensatory behaviors, a dimension possibly akin to ED such as eating disorders not otherwise specified (or bulimia nervosa). Food restriction, on the other hand, was characterized by fasting, skipping meals, and throwing away food, with no

Table 3Eating disorders patterns at age 13 years in girls and boys and contemporary/distal outcomes: standardized probit regression coefficients (standard errors) and *p* values

Patterns	Contemporary outcomes				Distal outcome
	Impairment	Burden	Any DSM-IV or ICD-10 emotional disorder	Any DSM-IV or ICD-10 behavioral disorder	BMI at 15 years
Girls (n = 2,990)					
Bingeing/overeating	.47 (.04) <i>p</i> < .0001	.60 (.05) <i>p</i> < .0001	.26 (.1) <i>p</i> = .008	.25 (.08) <i>p</i> = .002	.24 (.04) <i>p</i> < .0001
Weight and shape concern and weight control behaviors	.34 (.05) <i>p</i> < .0001	.16 (.06) <i>p</i> = .01	.04 (.1) <i>p</i> = .7	-.12 (.07) <i>p</i> = .1	.45 (.04) <i>p</i> < .0001
Food restriction	.06 (.04) <i>p</i> = .17	.17 (.06) <i>p</i> = .003	.08 (.1) <i>p</i> = .5	.35 (.08) <i>p</i> < .0001	-.15 (.05) <i>p</i> = .004
Boys (n = 3,006)					
Bingeing/overeating	.47 (.05) <i>p</i> < .0001	.61 (.06) <i>p</i> < .0001	.48 (.1) <i>p</i> < .0001	.56 (.09) <i>p</i> < .0001	.27 (.05) <i>p</i> < .0001
Weight and shape concern and weight control behaviors	.14 (.06) <i>p</i> = .02	-.15 (.08) <i>p</i> = .05	-.21 (1) <i>p</i> = .07	-.52 (.1) <i>p</i> < .0001	.54 (.06) <i>p</i> < .0001
Food restriction	.25 (.07) <i>p</i> < .0001	.36 (.08) <i>p</i> < .0001	.32 (.1) <i>p</i> = .006	.27 (.1) <i>p</i> = .006	-.24 (.07) <i>p</i> = .001

BMI = body mass index; DSM-IV = *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition; ICD-10 = *International Statistical Classification of Diseases and Related Health Problems*, 10th revision; SD = standard deviation.

ED cognitions; it possibly resembled food avoidant emotional disorder [17] and the newly defined avoidant/restrictive food intake disorder [18] and anorexia nervosa.

Dimensions identified were comparable to those identified in two studies using latent profile analysis and principal component analysis in adolescent clinical ED samples [19,20], which found a dimension characterized by ED cognitions and excessive exercise similar to our weight/shape concern and WCB pattern. Both studies also identified a component with no ED cognitions but some ED behaviors, similar to our food restriction dimension.

Associations with contemporary and distal outcomes

We found clear distinctions between ED symptoms dimensions in terms of their associations with adverse contemporary outcomes: Bingeing/overeating was highly associated with impact on the adolescent and burden to the family. This dimension was highly associated with emotional and behavioral disorders in boys and girls; moreover, it predicted a higher BMI *z*-score 2 years later.

Weight and shape concern and WCB seemed a relatively benign dimension cross-sectionally, because it was not associated with psychopathology in girls and with a lower probability of disorder in boys. Importantly, however, it had the strongest effect on higher BMI at 15 years of age, similarly across genders.

Food restriction was differentially associated with impairment and burden across genders, with a strong association in boys but less so in girls. In boys, it was highly associated with psychopathology. The association between food restriction and emotional disorders suggests that this pattern might be akin to food avoidant emotional disorder, as highlighted above [17].

Contrary to the other two dimensions, food restriction predicted lower BMI *z*-scores 2 years later. Post hoc analyses were carried out to determine whether this association could be explained by healthy weight loss strategies in subjects who were overweight at age 13 years or unhealthy weight control strategies in adolescents at normal weight or underweight at age 13 years. These analyses showed an association among boys between high scores on the food restriction dimension and overweight/obesity (BMI >25) at age 13 years. In girls, high

scores on the food restriction dimension were associated with normal weight (BMI between 18.5 and 25) at 13 years of age. Food restriction might therefore index different phenotypes in girls and boys: healthy weight loss for boys and unhealthy weight control strategies for girls. This might also explain differences in associations with contemporary variables.

There is evidence that ED across adolescence and unhealthy weight control behaviors in middle adolescence predict overweight and obesity [1,21,22]. Our study confirms and extends these findings by suggesting that both bingeing/overeating and weight concern and WCB patterns predict higher BMI 2 years later and might be risk factors for obesity.

Our findings should be interpreted taking into account relevant strengths and limitations. The main strengths include a large community-based sample of adolescents representative of the UK geographical area under study. We used a validated measure that closely reflects DSM and ICD diagnostic criteria for ED. We objectively measured BMI at face-to-face assessments. A wealth of data are available on potential confounders.

The study also has some limitations. Parental report was used to measure ED symptoms, psychopathology, impairment, and burden. Although parental report can be useful in diagnosing ED [23], there is evidence that parents might be better informants about some ED behaviors (for example, fasting and poor eating) but not about more secretive behaviors (such as purging) [24]. This could have resulted in an underestimation of purging and related behaviors.

Although response rates were high given the longitudinal nature of this sample (67.5%), attrition was present. However, sociodemographic variables predictive of attrition were included in all analyses.

Early adolescence is an age of major changes and transitions; therefore, the social and psychological implications of ED psychopathology need consideration. Because of the public health impact of obesity, it is important to understand pathways that might lead to adolescent obesity, and prevention of disordered eating might need to be included in obesity prevention strategies. Future work should clarify whether the dimensions identified are themselves precursors or early manifestations of full-blown ED that could be targeted for prevention.

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