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ARTICLE *in* EUROPEAN CHILD & ADOLESCENT PSYCHIATRY · NOVEMBER 2014

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ORIGINAL CONTRIBUTION

The developmental effects of media-ideal internalization and self-objectification processes on adolescents' negative body-feelings, dietary restraint, and binge eating

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Received: 17 June 2014 / Accepted: 7 November 2014

Abstract Despite accumulated experimental evidence of the negative effects of exposure to media-idealized images, the degree to which body image, and eating related disturbances are caused by media portrayals of gendered beauty ideals remains controversial. On the basis of the most up-to-date meta-analysis of experimental studies indicating that media-idealized images have the most harmful and substantial impact on vulnerable individuals regardless of gender (i.e., "internalizers" and "self-objectifiers"), the current longitudinal study examined the direct and mediated links posited in objectification theory among media-ideal internalization, self-objectification, shame and anxiety surrounding the body and appearance, dietary restraint, and binge eating. Data collected from 685 adolescents aged between 14 and 15 at baseline (47 % males), who were interviewed and completed standardized measures annually over a 3-year period, were analyzed using a structural equation modeling approach. Results indicated that media-ideal internalization predicted later thinking and scrutinizing of one's body from an external observer's standpoint (or self-objectification), which then predicted later negative emotional experiences related to one's body and appearance. In turn, these negative emotional experiences predicted subsequent dietary restraint and binge eating, and each of these core features of eating disorders influenced each other. Differences in the strength of these associations across gender were not observed, and all indirect effects were significant. The study provides valuable information about how the cultural values embodied by gendered beauty ideals negatively influence adolescents' feelings, thoughts and behaviors regarding their own body, and on the complex processes involved in disordered eating. Practical implications are discussed.

Keywords Binge eating · Media-ideal internalization · Objectification · Body image · Adolescents

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Introduction

The increased prevalence of eating disorders (EDs) and subclinical eating problems (i.e., binge eating, purging, unhealthy dieting practices) among adolescents, and their physical and psychosocial consequences, are well documented [1–7]. In addition, since evidence-based treatments produce symptom remission for only 35 to 50 % of clinical

Published online: 22 November 2014

populations [8], and effect sizes for prevention programs are small to moderate [9], much more effort is needed to elucidate factors associated with the development of eating pathology. Negative feelings about one's body have been identified as one of the most robust and best-replicated risk factors for EDs and subclinical ED symptoms [10–15], typically emerging from middle adolescence onwards (with peak incidence and prevalence occurring at age 17–18) [1–3, 5, 7, 13–15]. Thus, middle to late adolescence may represent an important developmental period for elucidating the complex aetiological processes of negative body-feelings and eating pathology so that optimally targeted interventions for this age group may be implemented.

The mass media's portrayal of an ultrathin physique for women and a lean-muscular physique (i.e., musculature coupled with low body fat) for men is though to be behind body discontent and eating pathology [16–20]. Despite accumulated evidence of the effects of acute exposure to media-idealized images on viewers' negative body-feelings and ED symptoms [16, 19–21], the degree to which body image and eating related disturbances are culturally bound issues, [22], linked to, and caused by media's portrayal of gendered beauty ideals continues to be an issue of debate see [19, 23–25]. The most recent and comprehensive meta-analysis of experimental studies [26] demonstrated that media-idealized images have the most harmful and substantial impact on vulnerable individuals (i.e., "internalizers" and "self-objectifiers"), regardless of media characteristics (i.e., frequency and length of exposure, media types) or gender. Although media-ideal internalization and self-objectification processes constitute two principal social-cognitive mechanisms through which media-idealized images exert their long-term influence on negative body-feelings and eating disturbances [17, 27–33], there remains a strong need for prospective research on their effects in developmentally appropriate samples [26–34]. In the current study, we aim to fill this gap in the literature, drawing upon objectification theory [35] to provide us with a testable framework for the proposed links.

For objectification theory in Western cultures, women, and to a lesser extent men, are frequently sexually objectified, meaning they are treated as a body, with beauty and attractiveness highly valued [35]. This sexual objectification is ubiquitous, occurring interpersonally across a variety of social interactions and mainly via media representations of female and male bodies that equate an individual's worth with the extent to which he/she fits the promoted standard of body size/shape [17, 27–32, 35–40]. Although women and men may experience the cultural meaning of such objectification differently, both genders may encounter sexual objectification and the associated consequences [17, 30, 31, 38–41]. According to the objectification theory proposed by Fredrickson and Roberts [35] and refined by Dakanalis and Riva [17], repeated sexual objectification experiences gradually encourage individuals to endorse the unrealistic body shape ideals portrayed in the media ("media-ideal internalization"). In doing so subjects adopt an observer's perspective on their own bodies and they learn to view and treat themselves as objects to be looked at and evaluated on the basis of physical appearance [17, 27–32, 35, 42]. Taking this observer's (or third-person) perspective on the self ("self-objectification") manifests as habitual body surveillance [28, 29, 32, 34, 42–44], whereby individuals monitor their compliance with the gender-specific sociocultural body shape ideals to avoid negative judgments from others [18, 38, 40–44]. In turn, self-objectification is theorized [17, 35] to lead to body shame and appearance anxiety, which could then motivate dietary restraint in an attempt to lose body fat to appear more consistent with the female thin-ideal and male lean-muscular ideal standards (as subcutaneous body fat can hide musculature [45]). Shame and anxiety surrounding the body and appearance are also theorized [17] to trigger binge eating either directly (as a means of coping with aversive feelings) or indirectly via dietary restraint through a variety of psychological mechanisms [17]; see also [12, 33, 46].

Since its inception, objectification theory has garnered considerable empirical support. Numerous studies employing American, Australian, Canadian, British, and Italian samples of adult women and men have found that self-objectification as a result of the internalization of body shape ideals portrayed in the media is associated with disordered eating via the mediators of body shame and appearance anxiety (see [28, 29, 32, 34] for reviews). Despite this extensive literature, only three studies have tested and supported the conceptual relations proposed by objectification theory as applied to adolescent disordered eating so far [47–49]. However, these studies did not investigate media-ideal internalization as an antecedent to the self-objectification process as well as potential gender differences in the strength of the examined associations. Further, all prior studies have been conducted cross-sectionally, and operationalized the core features of EDs (i.e., dietary restraint and binge eating [46]) as a single construct assessed via self-reported ED symptom composite measures [34].

The main goal of this study was to advance our understanding of the developmental effects of media-ideal internalization and self-objectification processes on adolescents' negative body-feelings and disordered eating. We aimed to extend prior research by conducting a prospective study to examine the conceptual relationships among the objectification theory variables as applied to dietary restraint and binge eating (assessed through a semi-structured clinical interview) in a large adolescent community sample. The postulated relations among the objectification theory variables under investigation are summarized in Fig. 1. The

complex pathways between the model variables (Fig. 1) were theoretically determined (i.e., the sequence of model variables followed the order specified by objectification theory [35] as refined by Dakanalis and Riva [17]) and analyzed using a latent variable structural equation modeling approach, while controlling for prior levels of the endogenous (i.e., dependent) variables in each instance [33, 50, 51].[1] We also held body mass index (BMI) and depression levels as time-varying covariates,[2, 3] [51]. It was expected that the objectification theory model (Fig. 1) would provide a good fit to the observed data. Additional aims of the study included testing if the strength of the associations among the objectification theory constructs is similar or differs across gender (after ensuring that their meaning does not vary by gender) and testing the significance of the indirect (or mediating) effects embedded within the model in each gender.

Methods

Participants and procedures

The participants were 718 adolescents, aged between 14 and 15 at the time of study entry, who completed clinical interviews and standardized measures, at baseline [Time 1 (T1); $N = 718$], 1-year [Time 2 (T2); $N = 711$], 2-year [Time 3 (T3); $N = 701$], and 3-year follow-ups [Time 4 (T4); $N = 685$]. This equated to 361 girls and 324 boys (T4). Participant attrition over the 3-year period was 4.6 %, but attrition analyses verified that participants whose data were missing at any follow-up did not significantly differ on demographic factors or any of the study variables when compared with the 685 adolescents who remained in the study.

The sample was recruited from randomly selected classes within twelve randomly selected Italian public (83 %) and private (17 %) schools. It contained nearly equal proportions of adolescents from urban, suburban, and rural communities from Northern, Central, and Southern Italy. At baseline, the mean age of participants was 14.54 years (SD = 0.28) and, on the basis of the BMI percentiles (see Footnote 2), 78.2 % were normal weight, 1.8 % were underweight, 15.6 % were overweight, and 4.4 % were obese; these percentages are consistent with estimates from Italian representative data of 15-year-old adolescents [55]. The sample was representative of the family-socio-economic and ethnic composition of the schools from which we sampled. In terms of family-socio-economic status, 66 % were middle class; 19 % lower-middle class; and 14 % upper-middle class, while for ethnicity 94 % self described as Caucasian; 2 % Hispanic/Latino; and 4 % other or mixed ethnic heritage. An active parental consent procedure was used to recruit volunteering participants, resulting in an average participation rate of 62 % of eligible adolescents. This rate is close to that of other school-recruited samples involving the use of multiple assessments and the same consent procedure, without offering incentives [7, 13]. All participants provided informed consent and assessments took place on the school campuses (after consent from school administrators was obtained) or participants' houses. Clinicians with at least 10 years' experience in assessing and treating adolescent EDs conducted all interviews, and the remaining standardized measures (see below) were administrated in counterbalanced order to offset possible ordering effects.

[1] As shown in Fig. 1 each of the constructs was assessed at a different point in time. Specifically, media-ideal internalization, self-objectification, negative body-feelings (i.e., body shame and appearance anxiety), and disordered eating (i.e., dietary restraint, binge eating) were measured at wave 1, 2, 3 and 4, respectively. Each wave was separated by a 1-year interval during which the variables under investigation can develop or change [13, 33, 50–53]. This spacing of the assessments across four waves and the statistical control of prior ($Time_x$-1) levels of each endogenous (dependent) variable would ensure temporal precedence of media-ideal internalization to self-objectification, of self-objectification to negative body-feelings, and of negative body-feelings to disordered eating [51]. However, in contrast to the other four endogenous (continuous) model variables (i.e., self-objectification, body shame, appearance anxiety, and dietary restraint), for binge eating we could not statistically control prior ($Time_x$-1) relevant levels, as this variable was operationalized categorically (see measures for details) at wave 4 (Fig. 1) [51]. In line with prior longitudinal research [33, 50] we assessed therefore binge eating episodes in each wave, and subsequently participants who reported binge eating episodes at the first three waves were excluded from main analyses (see binge eating in measures section). This strategy would both ensure a more rigorous and a truly prospective test of our hypothesis and prevent over-estimation of model parameters [33, 50, 51, 53], as there is increasing evidence that binge eating (if present) tends to be relatively stable or increase during the developmental period that the current study covers, and adolescents who report binge eating relative to those who did not, showed significantly higher levels of body mass, media-ideal internalization, negative affect, depressed mood, restraint, and body image concerns [4, 14, 50, 53, 54].

[2] Age- and sex-adjusted BMI centiles from the Centers for Disease Control and Prevention (CDC) [56] were used to determine whether participants at baseline were underweight (less than 5th percentile), normal weight (5th percentile to less than 85th percentile), overweight (85th percentile to less than 95th percentile) and obese (equal to or greater than the 95th percentile). However, as BMI percentiles are poorly suited for structural equation modeling analyses [51] and not recommended as a (proxy) measure of change in adiposity in longitudinal studies of adolescents see [57], in our planned statistical analyses BMI was used as a continuous variable that was z-standardized with respect to gender and age according to the CDC standards [56]. This permitted us to include the full scale of weight (z-BMI) and reduce potential measurement error [33, 51].

[3] As the present study was conducted as part of the Mind & Body Project [58]; see also acknowledgments available annual data regarding BMI and depression were used to provide an additionally conservative test of our hypotheses, as prior research suggests that both variables co-vary with ED and objectification theory constructs (Fig. 1) and their values differ over time (i.e., time-varying variables) [12, 32–34, 50, 52].

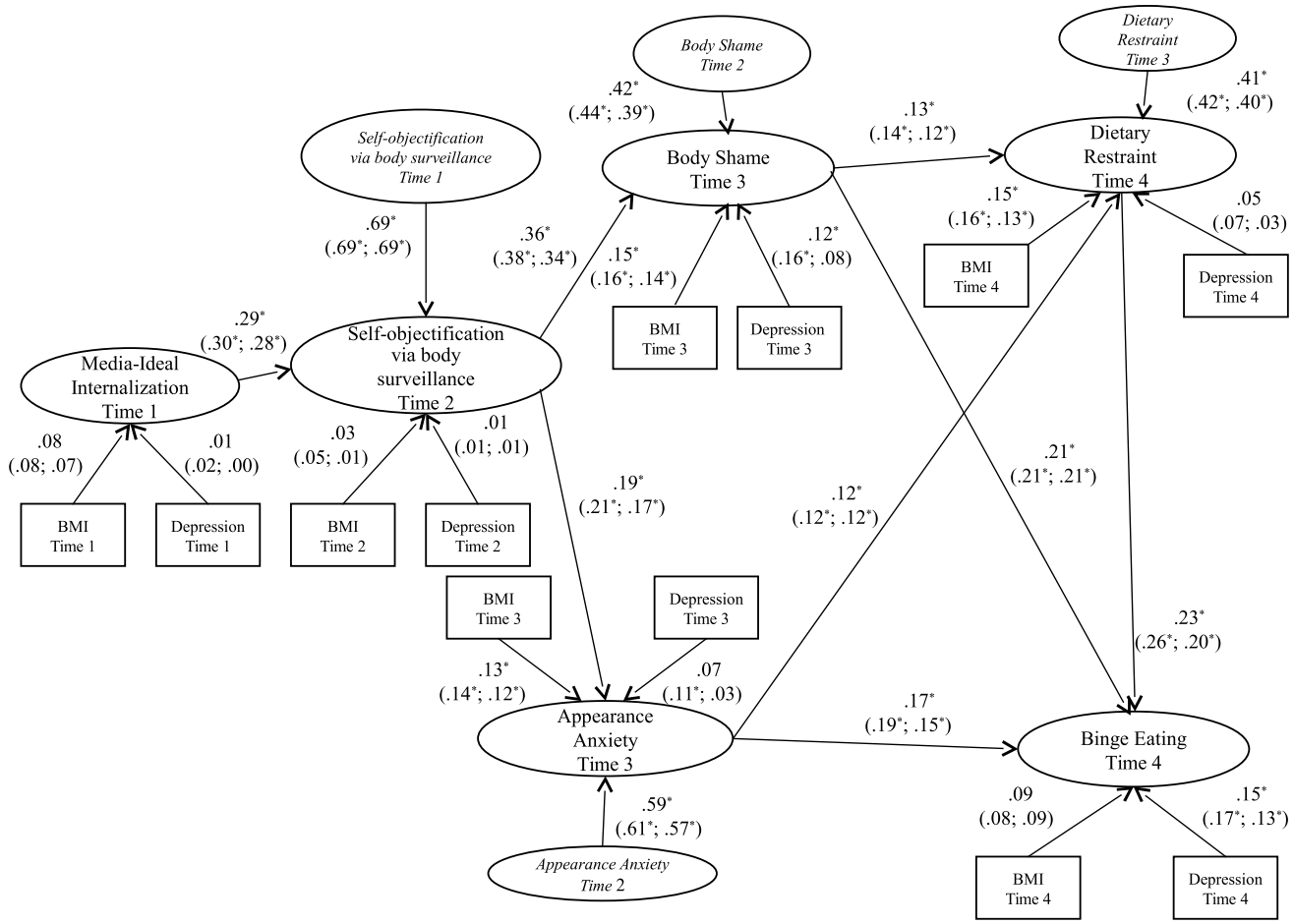


Fig. 1 The objectification structural model of eating pathology for the total sample ($N = 627$) with standardized coefficients. *Ellipses* represent unobserved latent variables or constructs. Constructs in *italics* are included to control for previous levels of the Time 2, Time 3, and Time 4 variables under investigation (participants who reported binge eating at Time 1 or between Time 1 and Time 3 were excluded from analyses). *Rectangles* represent observed/measured time-varying covariates. The values within parentheses are the path coefficients for the structural model for girls (*left side*; $N = 327$) and boys (*right side*; $N = 300$), respectively, $^*P < 0.05$

Measures

Media-ideal internalization: the 9-item General (e.g., "I don't try to look like the people on TV"; reverse item) and the 5-item Athletic Internalization (e.g., "I don't wish I looked as athletic as the people in magazines"; reverse item) subscales of the Italian version [59, 60] of the Sociocultural Attitudes Toward Appearance Questionnaire-3 (SATAQ-3) [61] were used to assess media-ideal internalization at T1. Research indicated that both subscales are critical in measuring females' and males' endorsement of media messages that espouse unrealistic body shape ideals and the striving toward such ideals see [18]. Each subscale is rated on a 5-point scale (1 *definitely disagree*, 5 *definitely agree*). Among Italian adolescents, both SATAQ-3 subscales demonstrated good internal consistency and test–retest reliability over a 3-week period ($\alpha = 0.84$–0.94; $r = 0.88$–0.89) [59, 60]. Their construct validity was demonstrated via associations with measures of negative body image, social comparison, conformity, and ED symptomatology [58–60, 62]. In the present study, internal consistency of the General and Athletic Internalization subscales at T1 were 0.88 and 0.87 for the female group, and 0.87 and 0.88 for the male group, respectively.

Self-objectification (*via body surveillance*): whereas self-objectification involves a broad orientation to valuing appearance attributes over other personal characteristics (e.g., competence) [36, 37], in line with prior objectification theory research [30, 38, 40, 47–49] we preferred to define it more narrowly as body surveillance [43, 44]. Indeed, the literature has often equated body surveillance with self-objectification using these constructs interchangeably [32, 34]. Nevertheless, some researchers describe these constructs as somewhat

distinct but highly related [39]. Thus, when discussing this construct as it relates to the current study, we have described it as self-objectification via body surveillance. We used the 8-item Body Surveillance subscale of the Italian version [58, 63] of the Objectified Body Consciousness Scale [43, 44] to assess this construct at T1 and T2. Body Surveillance subscale is rated on a 7-point scale (1 *strongly disagree*, 7 *strongly agree*) and measures the degree to which individuals consistently think of and monitor their bodies from an external observer's standpoint (e.g., "During the day, I think about how I look many times"). Among Italian community samples of adolescents [58], scores on this subscale garnered evidence of internal consistency ($\alpha = 0.87$–0.89) and test–retest reliability over a 3-week period ($r = 0.88$–0.89). Body surveillance scores were also positively associated with measures of desire to achieve the gendered body shape ideal, media-ideal internalization, body dissatisfaction, and disordered eating [58, 63]. In this study, alpha coefficients for the body surveillance subscale at T1 and T2 were: 0.88 and 0.89 (for females) and 0.87 and 0.88 (for males), respectively.

Body shame: the Body Shame subscale of the Italian version [58, 63] of the Objectified Body Consciousness Scale [43, 44] was used to assess the degree to which individuals feel shame about their bodies when they perceive themselves as falling short of meeting internalized shape ideals at T2 and T3. It consists of 8 items (e.g., "When I'm not the size I think I should be, I feel ashamed") rated on a 7-point scale (1 *strongly disagree*, 7 *strongly agree*). Among Italian community samples of adolescents [58], internal consistency and test–retest reliability over a 3-week period ($\alpha = 0.83$–0.86 and $r = 0.83$–0.85) were high. The subscale distinguished between adolescents with high and low levels of ED symptomatology [58], and was positively associated with measures of body checking, media-ideal internalization, self-esteem, and negative affect [58, 63]. In this study, reliability was good for both females ($\alpha = 0.87$ at T2 and T3) and males ($\alpha = 0.84$ at T2, and 0.86 at T3).

Appearance anxiety: the Italian version [58] of the Social Appearance Anxiety Scale [64] was used to assess anxiety surrounding overall appearance, including body shape, and fear of being negatively evaluated by others when the physique does not resemble cultural appearance standards [18] at T2 and T3. Its 16 items (e.g., "I feel comfortable with the way I appear to others"; reverse item) are rated on a Likert-type scale (1 *not at all*, 5 *extremely*). Among Italian adolescents [58], scores on this scale demonstrated test–retest reliability over a 4-week period ($r = 0.87$–0.88) and high internal consistency ($\alpha = 0.94$–0.96). The scale was also positively associated with teasing, media-ideal internalization, negative body image and social anxiety measures, and distinguished between adolescents with high and low levels of ED symptomatology [58]. In this study, reliability was high for both females ($\alpha = 0.95$ at T2 and 0.97 at T3) and males ($\alpha = 0.96$ at T2 and 0.97 at T3).

Dietary restraint: the Eating Disorder Examination 12.0D (EDE) [65] is a standardized investigator-based interview that generates operational ED diagnoses and assesses the severity of ED pathology in individuals from the age of 14 [66]. Except for diagnostic items, it yields four subscales (restraint, shape, weight, and eating concern) and provides information regarding the frequency of core eating disordered behaviors (i.e., binge eating) in the prior month of the assessment [65]. Dietary restraint at T3 and T4 was assessed using the 5-item Restraint subscale [rated on a 7-point forced-choice format (0–6)] of the Italian version of the EDE [67]. For a recent review of studies that examined internal consistency and inter-rater reliability, as well as construct validity of the EDE (including the Italian EDE), see Berg and colleagues [66]. Alpha coefficients for dietary restraint subscale at T3 and T4 were 0.87 and 0.87 (for females) and 0.86 and 0.87 (for males), respectively. A randomly selected subset of participants (30 % at each time point) was re-interviewed by a second blinded clinician, demonstrating high inter-rater reliability for the dietary restraint subscale: $r = 0.99$ at T3 and 1.00 at T4.

Binge eating: both objective binge eating (OBE; loss of control over eating and consumption of an objectively large amount of food) and subjective binge eating (SBE; loss of control over eating but without objectively large amount of food consumed) were considered in the assessment of binge eating as both forms are closely associated with psychological distress and other ED symptoms, and have been identified as equally important when assessing adolescent binge eating [2, 4, 33, 50]. OBE and SBE were both assessed with the Italian EDE [67] (for a description of EDE see above). In line with scholars' recommendations [2, 4] and prior research [33, 50], binge eating was conceptualized as a categorical variable, that is, as absent or present (i.e., $\geq$1 of an either OBE or SBE) in the month prior to the T4 assessment. Seventy-eight participants reported binge eating at T4, with 44 and 34 reporting SBE and OBE, respectively; the percentage and mean of SBE and OBE episodes (see Table 1) are close to those reported in other Italian studies of community samples of 17-18-year-old women and men [67, 68]. As noted (see Footnote 1) participants who reported binge eating in the month prior to the T1 ($N = 7$), T2 ($N = 15$), and T3 ($N = 36$) assessments were excluded from (main) analyses; thus, the *final sample* included data from 627 adolescents (327 girls and 300

boys).[4] A randomly selected subset of participants (30 % annually) was re-interviewed by a second blinded clinician. This resulted in high inter-rater reliability for the SBE ($k = 1.00$) and OBE ($k = 1.00$) at each time point.

Depression (*time-varying covariate*): in line with prior research [69], depressive symptoms were assessed using the depressive symptom Section (12 items) of the Italian [70] K-SADS-P (schedule for affective disorders and schizophrenia for school-age children—present episode version) semi-structured interview [71], which is appropriate for children and adolescents aged 6–18 years. Symptoms are rated on a 6-point scale (0–5) with severity ratings ranging from *none* to *severe*; severity ratings for each symptom were averaged to form a symptom composite [69] at each assessment point (T1–T4) (see Footnote 3). The Italian K-SADS-P has good inter-rater, internal consistency and test–retest reliability, and discriminated between non-depressed and depressed individuals [70]. The symptom composite has been shown to be a reliable measure of depressive symptom severity [69]. Alpha coefficients were 0.87 consistently across all time points for both genders. A randomly selected subset of participants (25 % annually) was re-interviewed by a second blinded clinician, demonstrating high inter-rater reliability for the symptom composite: $r = 0.95$–1.00.

BMI (*time-varying covariate*): during (T1–T4) (see Footnote 3) assessment, participants' height and weight were used to calculate BMI $(kg/m^2)^2$.

Statistical analyses

Girls and boys were compared in terms of their score on each study measure with an independent-sample *t* test to calculate statistical significance and Cohen's effect size (*d*) to estimate its relative magnitude (small = 0.2, medium = 0.5, large = 0.8). For the main purpose of the study, latent variable structural equation modeling analyses were performed in Mplus 6.12 [72] with the full information maximum likelihood estimation because pre-analysis of the data did not reveal any evidence for multivariate non-normality, there was little missing data (0.4 % missing respondents at T1), and the selected estimator produces more accurate and efficient parameter estimates than alternative imputation approaches and maximizes statistical power [51, 72, 73]. Latent variable structural equation modeling involves estimation of a (a) measurement and (b) structural model [73]. The measurement model tests the proposed measurement of study constructs by estimating factor loadings between observed indicators and underlying latent variables using confirmatory factor analysis. In this study, media-ideal internalization latent variable was specified using mean scores of each SATAQ-3 subscale (i.e., general and athletic internalization) as the observed indicators, whereas in line with prior research [33] OBE and SBE were used as dual indicators for the binge eating latent variable. As in latent variable structural equation modeling analyses at least two indicators for each latent variable are needed [73], and because parceling offers many advantages over item-level modeling (i.e., greater parsimony, reduction of sampling error, fewer chances for correlated residuals [51, 73]), the 3-step procedure outlined by Russell et al. [74] was followed to generate three indicators/parcels for each of the remaining four latent variables (i.e., self-objectification via body surveillance, body shame, appearance anxiety, and dietary restraint). In the first step, an exploratory factor analysis using the maximum likelihood method with a single factor extraction was conducted, using the total sample ($N = 627$) of participants for each scale/subscale used to assess the four latent variables. In the second step, items were rank-ordered according to the absolute magnitude of the factor loadings and successively assigned (from the highest to the lowest factor loading) to one of three parcels in order to equalize the average loadings of each parcel on its respective latent factor. In the third and final step, items were averaged for each parcel to arrive at a total parcel score. Parcels were then used to estimate their respective latent variable within the latent variable structural equation modeling analyses.[5]

[4] Although participants who reported binge eating at the month prior to the first three annual assessments ($n = 36$), relative to those who did not, showed significantly higher mean scores in all study variables, there were no significant differences in terms of demographics between these two groups. Given that some readers might wonder if the results from the model under investigation would have changed if the 36 participants had been included, the structural model (Fig. 1) was re-estimated including these participants. Because this had the effect of amplifying the range of all model variables, we noted the expected increases in structural parameter estimates (relative to the sample without these participants) ($\beta|\Delta| = 0.06$–0.16, $M|\Delta| = 0.10$, $SD\ |\Delta| = 0.03$) and in the proportion of total variation of each endogenous variable (3.1–7.8 %) explained by the model. In line with prior research [33, 50] we reported the more conservative analysis without the inclusion of 36 cases to avoid over-estimation (even minor) of structural parameters and ensure that we conducted a truly prospective test of our hypothesis [51, 53]. Due to space considerations, the detailed results of the analyses briefly reported here are available from the corresponding author upon request.

[5] To ensure that measures assessed at multiple time points (i.e., self-objectification via body surveillance, body shame, appearance anxiety, dietary restraint) were not allowed to change over time, the same items in the three parcels for these measures were included at initial (i.e., self-objectification via body surveillance at T1) and later (i.e., self-objectification via body surveillance at T2) time points [51, 73]. Also, to control for possible systematic error due to the repeated assessment, the measurement error amongst the identical observed indicators of the latent variables was allowed to be correlated over time [51, 73]. For instance, the measurement error for the 1st observed indicator of self-objectification via body surveillance from T1 was allowed to correlate with the measurement error for the same 1st observed indicator of self-objectification via body surveillance at T2. This was also done for the 2nd and 3rd observed indicators of self-objectification via body surveillance from T1 and T2. In the same manner, correlated error for the observed indicators of the other longitudinal latent variables (i.e., body shame, appearance anxiety, dietary restraint) were included.

Table 1 Descriptive statistics of study measures and comparison by gender

Measure	Girls *M* (SD)	Boys *M* (SD)	*t*	*d*
SATAQ-3: general internalization subscale[a, g] Time 1	22.99 (4.01)	22.50 (5.12)	1.34	0.11
SATAQ-3: athletic internalization subscale[b, g] Time 1	10.25 (4.84)	12.88 (3.39)***	7.81	0.62
OBCS: body surveillance subscale[c, g] Time 1	3.97 (0.81)	3.69 (0.88)***	4.15	0.33
BMI[g] Time 1	19.80 (2.76)	20.55 (2.99)***	3.27	0.26
K-SADS-P-DSS symptom composite[d, g] Time 1	20.85 (7.08)	18.72 (6.60)***	3.89	0.31
OBCS: body surveillance subscale[c, g] Time 2	4.02 (0.82)	3.74 (0.87)***	4.14	0.33
OBCS: body shame subscale[c, g] Time 2	3.33 (0.80)	3.18 (1.04)*	2.04	0.16
SAAS[e, g] Time 2	37.26 (12.18)	35.14 (13.90)*	2.03	0.16
BMI[g] Time 2	20.39 (2.99)	21.13 (3.49)**	2.85	0.23
K-SADS-P-DSS symptom composite[d, g] Time 2	23.28 (7.56)	18.60 (6.48)***	8.28	0.66
OBCS: body shame subscale[c, g] Time 3	3.55 (0.92)	3.48 (0.94)	0.94	0.07
SAAS[e, g] Time 3	37.77 (12.22)	36.55 (13.88)	1.17	0.09
EDE: restraint subscale[f, g] Time 3	1.02 (1.11)	0.81 (0.98)**	2.50	0.20
BMI[g] Time 3	21.01 (3.67)	22.00 (3.96)***	3.25	0.26
K-SADS-P-DSS symptom composite[d, g] Time 3	23.16 (7.80)	19.21 (6.96)***	6.67	0.53
EDE: restraint subscale[f, g] Time 4	1.27 (1.31)	1.05 (1.17)*	2.21	0.18
EDE: ≥1 subjective binge eating episode (6.4 %)[h] Time 4	2.95 (4.41)	2.43 (3.12)	1.69	0.13
EDE: ≥1 objective binge eating episode (4.9 %)[i] Time 4	2.65 (3.55)	3.04 (4.09)	1.27	0.11
BMI[g] Time 4	21.53 (4.03)	22.52 (4.52)**	2.89	0.23
K-SADS-P-DSS symptom composite[d, g] Time 4	22.56 (7.68)	18.84 (7.20)***	6.24	0.49

SATAQ-3 Sociocultural Attitudes Toward Appearance Questionnaire-3, *OBCS* Objectified Body Consciousness Scale, *BMI* Body Mass Index, *K-SADS-P-DSS* Kiddie schedule for affective disorders and schizophrenia-Present episode version-Depressive symptom section, *SAAS* Social Appearance Anxiety Scale, *EDE* Eating Disorder Examination-Interview-12.0D

[a] Possible score range 9–45

[b] Possible score range 5–25

[c] Possible score range 1–7

[d] Possible score range 0–60

[e] Possible score range 16–80

[f] Possible score range 0–6

[g] $df = 625$ ($N = 627$)

[h] $df = 42$ ($N = 44$)

[i] $df = 32$ ($N = 34$)

* $P < 0.05$; ** $P < 0.01$; *** $P \leq 0.001$

The structural model retains the components of the measurement model and tests the specified relationships (the directional paths; see Fig. 1) between latent variables while controlling for prior levels of the endogenous latent variables in each instance [33, 50, 51]. BMI *z* scores (see Footnote 2) and depression levels were observed time-varying covariates (i.e., specified to predict the latent variable assessed at the same time point; see Fig. 1) in the model [51]. Criteria for good measurement and structural model fit were: comparative fit index and Tucker-Lewis index values ≥0.95, standardized root-mean-square residual values ≤0.08, and root-mean-square error of approximation (RMSEA) values ≤0.06 [75]. The Chi-square statistic (χ^2) and the RMSEA confidence intervals (CIs) are also reported.

Following Byrne's [73] recommendations after testing the proposed measurement and structural model in the entire sample ($N = 627$), participants were grouped according to gender, and multi-group structural equation modeling analyses were performed to determine whether the factor loadings and structural paths values differed or were similar across gender (i.e., to investigate invariance). Factor loading (measurement) and structural invariance is supported if the strength of the factor loadings and the path estimates is equivalent across groups, respectively. To test for invariance, constrained (i.e., measurement or structural parameters were fixed to be equal for the groups) and unconstrained (i.e., parameters were allowed to vary) models were compared using the $\Delta\chi^2$ [73]; a non-significant

Table 2 Goodness-of-fit indices for the measurement and structural model, and evaluation of measurement and structural invariance across gender

Model	χ^2 (*df*)	CFI	TLI	SRMR	RMSEA (90 % CIs)	Comparison	$\Delta\chi^2$ (Δdf)
Measurement model (Model 1)[a]	530.33* (293)	0.974	0.970	0.054	0.041 (0.031, 0.051)		
Constrained measurement model (Model 2)[b]	1158.55* (604)	0.973	0.970	0.054	0.041 (0.032, 0.051)		
Unconstrained measurement model (Model 3)[b]	1136.85* (586)	0.973	0.970	0.054	0.042 (0.032, 0.052)	Models 2–3[c]	21.70 (18)
Structural model (Model 4)[a]	601.65* (317)	0.970	0.968	0.060	0.048 (0.038, 0.060)		
Constrained structural model (Model 5)[b]	1313.43* (642)	0.968	0.967	0.063	0.049 (0.040, 0.061)		
Unconstrained structural model (Model 6)[b]	1302.29* (634)	0.968	0.967	0.063	0.050 (0.040, 0.062)	Models 5–6[d]	11.14 (8)

χ^2 Chi-square, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker-Lewis Index, *SRMR* standardized root-mean-square residual, *RMSEA* root-mean-square error of approximation, *CIs* Confidence Intervals, Δ difference values

[a] $N = 627$

[b] $N = 327$ girls, $N = 300$ boys

[c] Testing for factor loading invariance (multiple-group analysis) across gender

[d] Testing for structural invariance (multiple-group analysis) across gender

* $P < 0.001$

$\Delta\chi^2$ indicates that model parameters are invariant across gender. For testing the significance of the indirect effects, Mplus 6.12 [72] was specified to (a) create 5,000 bootstrap samples from the data set by random sampling with replacement, and (b) generate indirect effects and bias-corrected CIs around the eight indirect effects when analyzing the structural model displayed in Fig. 1. If the 95 % CI does not include zero, the indirect effect is statistically significant at 0.05 [73].

Results

Descriptive statistics of study measures and comparison by gender are reported in Table 1.

Examination of measurement model and factor loading invariance

An initial test of the measurement model resulted in a good fit to the data (Model 1, Table 2) and all factor loadings were statistically significant. Furthermore, the results of multiple-groups analysis revealed factor loading invariance across gender, as the difference in fit between the constrained and unconstrained models was non-significant (Models 2–3, Table 2). Thus, all latent variables were adequately operationalized (by their respective observed indicators) and their meaning does not vary by gender.[6] The standardized factor loadings for each gender are shown in Table 3.

Examination of structural model and invariance

The structural model provided a good fit to the data (Model 4, Table 2) and all paths were significant.[7] The model, controlling for time-varying covariates (i.e., BMI *z* scores (see Footnote 2) and depression levels), accounted for 67.3 % of the variance in T2 self-objectification via body surveillance, 54.9 % of the variance in T3 body shame, 54.4 % of the variance in T3 appearance anxiety, 45.7 % of the variance in T4 dietary restraint, and 42.4 % of the variance in T4 binge eating. The results of multiple-groups analysis did not reveal structural path differences across gender, as the difference in fit between the constrained and unconstrained models[8] was non-significant (Models 5–6, Table 2). The structural path coefficients for each gender are displayed in Fig. 1.

Test for significance of indirect effects

The structural model (Fig. 1) was used in the bootstrap procedure to test the significance of the indirect effects. As

[6] As the current manuscript includes the maximum permitted number of tables and figures, the correlations among the 10 latent variables and the 28 observed indicators and time-varying covariates stratified by gender are available on request from the corresponding author.

[7] Modification indices provided by Mplus were detected in both the measurement and structural model but their magnitude (<5.0) suggested that any not originally specified parameters did not impact the fit of model to the data [73].

[8] In each model path coefficients from the time-varying covariates and constructs included to control for previous levels of the endogenous variables to the latent variables were allowed to vary across groups, as recommended [51, 73].

Table 3 Standardized factor loadings for the measurement model

Latent variable and observed indicators	Factor loading
MI Time 1	
SATAQ3-GI Time 1	0.88/0.87[a]
SATAQ3-AI Time 1	0.80/0.84*
SOVBS Time 1	
OBCS-BSV Parcel 1 Time 1	0.82/0.81[a]
OBCS-BSV Parcel 2 Time 1	0.91/0.93*
OBCS-BSV Parcel 3 Time 1	0.87/0.86*
SOVBS Time 2	
OBCS-BSV Parcel 1 Time 2	0.85/0.83[a]
OBCS-BSV Parcel 2 Time 2	0.90/0.88*
OBCS-BSV Parcel 3 Time 2	0.83/0.84*
BSH Time 2	
OBCS-BSH Parcel 1 Time 2	0.88/0.90[a]
OBCS-BSH Parcel 2 Time 2	0.83/0.81*
OBCS-BSH Parcel 3 Time 2	0.83/0.85*
AA Time 2	
SAAS Parcel 1 Time 2	0.93/0.94[a]
SAAS Parcel 2 Time 2	0.80/0.79*
SAAS Parcel 3 Time 2	0.85/0.83*
BSH Time 3	
OBCS-BSH Parcel 1 Time 3	0.90/0.91[a]
OBCS-BSH Parcel 2 Time 3	0.80/0.79*
OBCS-BSH Parcel 3 Time 3	0.84/0.84*
AA Time 3	
SAAS Parcel 1 Time 3	0.95/0.94[a]
SAAS Parcel 2 Time 3	0.83/0.84*
SAAS Parcel 3 Time 3	0.84/0.85*
DR Time 3	
EDE-R Parcel 1 Time 3	0.89/0.88[a]
EDE-R Parcel 2 Time 3	0.74/0.71*
EDE-R Parcel 3 Time 3	0.83/0.84*
DR Time 4	
EDE-R Parcel 1 Time 4	0.88/0.89[a]
EDE-R Parcel 2 Time 4	0.73/0.74*
EDE-R Parcel 3 Time 4	0.84/0.83*
BE Time 4	
EDE-SBE Time 4	0.84/0.84[a]
EDE-OBE Time 4	0.83/0.83*

Values for girls ($N = 327$) are presented to the left of the diagonal, whereas values for boys ($N = 300$ boys) are presented to the right of the diagonal

MI Media-ideal internalization, *SOVBS* Self-objectification via body surveillance, *BSH* Body shame, *AA* Appearance anxiety, *DR* Dietary restraint, *BE* Binge eating, *SATAQ3-GI*, and *AI*, Sociocultural Attitudes Toward Appearance Questionnaire-3-General Internalization subscale, and Athletic Internalization subscale, respectively, *OBCS-BSV 1-3* three parcels from the Body Surveillance subscale of Objectified Body Consciousness Scale, *OBCS-BSH 1-3* three parcels from the Body Shame subscale of Objectified Body Consciousness Scale, *SAAS 1-3* three parcels from the Social Appearance Anxiety Scale, *EDE-R 1-3* three parcels from the Restraint subscale of Eating Disorder Examination-Interview-12.0D, *EDE-SBE*, and *OBE* Eating Disorder Examination-Interview-12.0D, subjective and objective binge eating, respectively

[a] These loadings were fixed to one so that the measurement model would be identified (i.e., to provide a scale of measurement for the factor loadings). Therefore, no significance test is reported for these loadings

* $P < 0.001$

shown in Table 4, all indirect effects of the model were statistically significant[9] for both genders, suggesting mediation. That is, initial levels of (T1) media-ideal internalization predicted future (T3) body shame and (T3) appearance anxiety through future (T2) self-objectification via body surveillance; the latter predicted (a) future (T4) dietary restraint through future (T3) body shame and (T3) appearance anxiety, and (b) future (T4) binge eating through future (T3) body shame and (T3) appearance anxiety. Dietary restraint (T4) also served as an additional mediator of the links between (T3) body shame and (T4) binge eating, and (T3) appearance anxiety and (T4) binge eating. The type of mediation (partial or full) was determined by whether there was a significant direct path in the structural model (Fig. 1) or not; if not, this would indicate full mediation. For each analysis, the results are also presented in Table 4.

[9] As all existing effect sizes measures proposed in the mediation context are limited to the simple cross-sectional mediational models [76] see for details we did not quantify the size of the indirect effects either *per se* or as compared with some specified value [51].

Table 4 Tests of mediation: examination of indirect effects

Indirect path	β	95 % CIs	Direct path significant?	Full or partial mediation
M1 T1 → SOVBS T2 → BSH T3	0.11*/0.10*	0.057–0.184/0.071–0.199	No/No	Full/Full
M1 T1 → SOVBS T2 → AA T3	0.06*/0.05*	0.013–0.126/0.025–0.139	No/No	Full/Full
SOVBS T2 → BSH T3 → DR T4	0.05*/0.04*	0.019–0.098/0.006–0.097	No/No	Full/Full
SOVBS T2 → AA T3 → DR T4	0.03*/0.03*	0.007–0.064/0.004–0.052	No/No	Full/Full
SOVBS T2 → BSH T3 → BE T4	0.08*/0.07*	0.033–0.163/0.018–0.143	No/No	Full/Full
SOVBS T2 → AA T3 → BE T4	0.04*/0.03*	0.010–0.101/0.004–0.065	No/No	Full/Full
BSH T3 → DR T4 → BE T4	0.04*/0.02*	0.011–0.088/0.005–0.059	Yes/Yes	Partial/Partial
AA T3 → DR T4 → BE T4	0.03*/0.02*	0.007–0.067/0.003–0.063	Yes/Yes	Partial/Partial

Values for girls ($N = 327$) are presented to the left of the diagonal, whereas values for boys ($N = 300$ boys) are presented to the right of the diagonal

β bootstrap standardized indirect path coefficients, *95 % CIs* 95 % bias-corrected confidence intervals, *T1–T4* Time 1, 2, 3, and 4, *MI* Media-ideal internalization, *SOVBS* Self-objectification via body surveillance, *BSH* Body shame, *AA* Appearance anxiety, *DR* Dietary restraint, *BE* Binge eating

* $P < 0.05$

Additional analyses: further exploring the (T4) dietary restraint-binge eating relationship

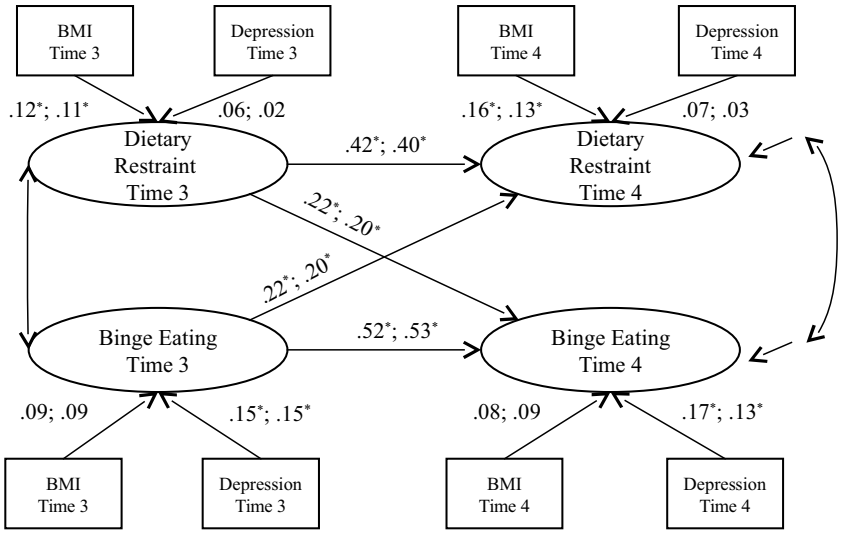
Consistent with our hypotheses, the results (Fig. 1; Table 4) indicated that (T3) negative body-feelings predicted later (T4) dietary restraint, which, in turn, predicted (T4) binge eating. However, it is unclear whether dietary restraint does in fact precede binge eating (or vice versa), since both variables were assessed at the same time point (T4). To address this issue (and as data for binge eating at T3 were available), we tested a cross-lagged panel model [51] holding BMI z scores (see Footnote 2) and depression levels as time-varying covariates to determine (a) whether (T3) dietary restraint would significantly predict (T4) binge eating, and (b) whether (T3) binge eating would significantly predict (T4) dietary restraint. In order to examine the model, the 36 individuals excluded by prior analyses (see "Measures" section) were then considered. Thus for this analysis the sample ($N = 663$) consisted of 346 girls and 317 boys. As shown in Fig. 2, (T3) dietary restraint significantly predicted (T4) binge eating, and (T3) binge eating significantly predicted (T4) dietary restraint for both adolescent girls and boys. For each gender, the goodness-of-fit model is also reported in Fig. 2.

Discussion

Although the theorized associations among the objectification theory latent variables are consistent with outcomes of prior cross-sectional studies employing non-clinical samples of adults (see [28, 29, 32, 34] for reviews) and adolescents of both genders [47–49], to our knowledge, this was the first study that has examined prospectively and supported the theoretical underpinnings of objectification theory, following participants through the period of greatest risk for the emergence and growth of eating pathology [1–5, 12–14].

While boys may not necessarily experience evaluation of their bodies to the same extent as girls in the interpersonal context [27, 28], there is increasing evidence that boys are similarly over-stimulated by unrealistic body shape ideals and objectified in contemporary mass media [19, 26, 30, 38, 40, 77]. In accordance with scholars' suggestion that men may be likely to internalize the masculine beauty ideal perpetuated by the media as the only type of body to be valued [16–18, 30, 31, 40], which would result in self-objectification similar to the process observed for women [30, 31, 38–41, 63], our results indicated that initial (T1) levels of media-ideal internalization predicted (T2) self-objectification via body surveillance and these associations were equivalent across gender. In turn, (T2) self-objectification via body surveillance predicted later (T3) body shame and (T3) appearance anxiety.

Overlapping sociocultural models of EDs (see [16, 29, 38] for a comprehensive review) posit that girls and boys who have endorsed media messages that promote unrealistic ideals for beauty and attractiveness and the striving toward such ideals would be at risk for developing negative body-feelings (and subsequent disordered eating) when the gendered ideals are not actualized. However, these models (i.e., the dual pathway model of binge eating) currently lack comprehensive explanations as to how media-ideal internalization contributes to negative body-feelings [29, 50]. Consistent with objectification theory [17, 35], our results provide some evidence that through self-objectification (via body surveillance), which may serve as a mechanism enabling individuals to evaluate their standing relative to the



Fit indices (girls):
$\chi^2(32, N = 346) = 54.40, P < 0.001$
CFI= 0.968, TLI = 0.967, SRMR = 0.064
RMSEA = 0.050 (90% CIs: 0.040, 0.060)

Fit indices (boys):
$\chi^2(32, N = 17) = 59.58, P < 0.001$
CFI= 0.966, TLI = 0.966, SRMR = 0.065
RMSEA = 0.050 (90% CIs: 0.040, 0.061)

Fig. 2 Cross-lagged effects for adolescents girls (*left side*; $N = 346$) and boys (*right side*; $N = 317$), respectively. *Ellipses* and *rectangles* represent unobserved latent variables and observed/measured time-varying covariates, respectively. For the examination of the models, the 36 individuals excluded by prior analyses (i.e., adolescents who began binge eating between Time 2 and Time 3) are now considered; thus, for the results presented here, the sample included data from 663 adolescents *2* Chi-square, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker-Lewis Index, *SRMR* standardized root-mean-square residual, *RMSEA* root-mean-square error of approximation, *CIs* Confidence Intervals $^*P < 0.05$

gendered beauty ideals [29, 38, 40, 43, 44, 63], women and men may come to recognize a discrepancy between their current and ideal physique [29–31, 34, 38, 63, 78] and, as a result, experience feelings of anxiety and shame about their body and appearance [18, 58]. Prior cross-sectional studies [30, 31, 40, 63] have examined and strongly supported the mediating role of self-objectification in the relationship between media-ideal internalization and negative body-feelings among women and men (see also [32, 34, 38] for reviews), but these studies have not used prospective designs or tested adolescent samples.

Objectification theory proposed by Fredrickson and colleagues [35] and refined by Dakanalis and Riva [17], posits that negative body-feelings resulting from self-objectification could (a) lead to rigid, rule-directed behaviors marked by total abstinence of forbidden foods and/or extreme dieting efforts, and (b) trigger binge eating as a means of coping with aversive feelings. Accordingly, we did not observe a direct association between (T2) self-objectification via body surveillance and later (T4) dietary restraint or (T4) binge eating; these associations were fully mediated by (T3) negative body-feelings. Prior experimental studies found that self-objectification resulted in increased negative body-feelings, which were then predictive of dieting practices among adults in the later phases of these studies [36, 79]. The role of negative body-feelings in the onset of binge eating, a central assumption of the affect regulation theories [80], is also well documented in previous research among community samples of adults of both genders and adolescent girls (see [12, 80] for reviews). Therefore, our results extended previous findings to adolescents of both genders.

Negative body-feelings are also theorized to indirectly trigger binge eating through dietary restraint within objectification framework [17]. Despite evidence of the effects of feelings of caloric deprivation associated with restriction in the amount of food consumed and violation of inflexible dietary rules on binge eating [13, 14, 23, 33, 50, 81],[10] it has been suggested that this direction of influence may be reversed and that binge eaters may attempt to avoid and or limit the subsequent weight/body fat gain resulting from binge eating episodes via dieting [12, 81, 82]. The results of additional analyses (Fig. 2) indicating that dietary restraint and binge eating predicted each other over time are consistent with the simultaneous operation of both proposed processes [12–14, 23, 33, 45, 50, 81]. These findings suggest that dietary restraint increases the likelihood of binge eating, but repeated binge eating episodes serves to perpetuate dietary efforts [12, 46]. It should be noted, however, that the only known study examining the temporal relations between dietary restraint and binge eating among 143 undergraduate women, aged between 19 to 38 years [82], failed to support any of the associations observed here. Although the conflicting findings between these studies cannot be easily interpreted as Spoor et al. [82] assess the latent variables via different self-report measures of restrained eating and bulimia, a possible explanation might be the difference in sample characteristics, particularly age. It might be possible that the temporal relationships between dietary restraint and binge eating are evident in

[10] For contradictory findings and potential explanations especially in terms of methodological and statistical shortcomings, see [12, 81].

adolescence, but not in adulthood. In support of this suggestion, meta-analytic findings revealed that the effects of risk factors are significantly weaker for adult samples relative to adolescent samples regardless of gender [12]. Because of the important aetiological implications, it will be crucial for future researchers to further test and elucidate the feedback loops [51] emerging here within various developmental periods.

Although the study provides the first prospective test of the objectification theory model as applied to disordered eating, it is risky to embrace causal conclusions without direct experimental evidence. Even with longitudinal data and inclusion of certain time-varying covariates within latent variable structural equation modeling analyses, unmeasured third variables could explain any relationship observed, such as genetic factors. In addition, although in line with prior research [33, 50] and scholars' recommendations [51], prior levels of the endogenous latent variables in each instance were controlled for within our analyses, further studies should be more rigorous in collecting data at every time point to allow for more sophisticated testing of theorized mediational mechanisms (i.e., fully cross-lagged model). For instances where clinical interview protocols for objectification theory variables did not exist, we utilized measures with established psychometric proprieties among Italian adolescents. Nevertheless, the findings are somewhat susceptible to erroneous reporting, and therefore replication with other methods of data collection (i.e., ecological momentary assessment) and additional informants would strengthen the interpretation and validity of the current results. Finally, our study was limited by the ethnic homogeneity of our respondents, so the generalizability of the results to non-Italian speaking populations and racial groups remains to be seen. Further research on adolescent samples with EDs is also required.

In conclusion, the current study highlights the importance of the intervening factors in the relations among media-ideal internalization, negative emotional experiences related to one's body, and disordered eating among adolescents. Specifically, the results suggest that regardless of gender (a) self-objectification (via body surveillance) may serve as a mechanism which translates the media-ideal internalization into negative body-feelings, and (b) body shame and appearance anxiety may constitute the mechanisms through which thinking and scrutinizing of one's own body from an external observer's perspective contributes to dietary restraint and binge eating. Each of these core features of EDs has been found to predict each other (feedback loop) [51]. Consistent with objectification framework [17, 35], targeting adolescents' negative body-feelings and their theorized common precursor (i.e., self-objectification) might be considered as a potential intervention strategy to prevent and treat eating pathology [27, 28, 32, 34, 42]. At present, cognitive dissonance, the current main line of body and eating-related prevention programming [9], targets media-ideal internalization by inducing cognitive dissonance with respect to pressures to meet gendered beauty ideals (for details see [9, 10]). Results from this study suggest that such interventions might be even more effective if they also targeted the self-objectification that seems to stem from media-ideal internalization. Indeed, a recent study has shown that the addition of self-objectification as a target variable within traditional cognitive dissonance programs increased the reduction of body image and eating related disturbances as well as the effect sizes of the traditional cognitive dissonance program [83], which ranged from small to moderate for outcomes [9, 84, 85].

Acknowledgments This study was conducted as part of the Mind and Body Project at the University of Pavia (which involves a series of independent studies aiming at validating numerous body image measures, and examining prospectively the associations among body image and full-blown AXIS I disorders among both clinical and community samples [58]) and supported by a grant from the Onassis Foundation (O/RG 12410). Special appreciation is expressed to all participants and their parents.

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

Ethical standards Informed consent was obtained from both the youngsters and their parents. The study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments, and the study was approved by the Institutional Review Board of the University of Pavia (ID No: 2228/009).

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