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Examining the Momentary Relationships Between Body Checking and Eating Disorder Symptoms in Women with Anorexia Nervosa

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Abstract

Body checking is common among individuals with anorexia nervosa (AN) and increases risk for dietary restriction. However, no study has examined whether body checking increases the immediate risk for engaging in other harmful weight loss behaviors, or whether this relationship is moderated by person-level traits. The current study utilized ecological momentary assessment (EMA) to examine whether (a) body checking predicted rapid use of weight loss behaviors, and (b) whether eating-related obsessionality/compulsivity moderated this relationship. Women with full or subthreshold anorexia nervosa ($N=118$) completed a measure of eating-related obsessionality/compulsivity at baseline, followed by a 14-day EMA protocol during which they reported on body checking and weight loss behaviors (i.e., exercise, self-induced vomiting,

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Author Statement

Allyson V. Goeden: Conceptualization, Formal analysis, Writing - Original draft, Writing - Review & Editing; **Lauren M. Schaefer:** Conceptualization, Writing - Original draft, Writing - Review & Editing; **Ross D. Crosby:** Conceptualization, Formal analysis, Writing - Review & Editing; **Carol B. Peterson:** Writing - Review & Editing; **Scott G. Engel:** Writing - Review & Editing; **Daniel Le Grange:** Writing - Review & Editing; **Scott J. Crow:** Writing - Review & Editing; **Stephen A. Wonderlich:** Writing - Review & Editing.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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laxative use, skipping meals, and increasing fluid intake). In a series of generalized linear mixed models, within-person effects indicated that momentary body checking significantly predicted subsequent meal skipping and using fluids to curb appetite. Between-person effects indicated that individuals who engage in more frequent body checking also engage in a higher frequency of self-induced vomiting, meal skipping, and use of fluids to curb appetite. An individual's degree of eating-related obsessionality/compulsivity did not moderate any of these relationships. Findings highlight body checking as an immediate precursor of dangerous weight loss behaviors among individuals with AN, and underscore the need for clinicians to address body checking during treatment.

Keywords

obsessive compulsive traits; anorexia nervosa; ecological momentary assessment; EMA; body checking

Anorexia nervosa (AN) is a serious psychiatric condition characterized by the maintenance of an objectively low body weight, fears of weight gain, and disturbances in body image (American Psychiatric Association, 2013). Current diagnostic criteria identify two subtypes of the disorder: a restricting type (in which low body weight is primarily maintained via restricted dietary intake and/or engagement in excessive exercise) and a binge-eating/purging type (in which individuals exhibit recurrent episodes of binge eating and/or purging behaviors such as self-induced vomiting or misuse of laxatives and diuretics). Importantly, AN is associated with significant medical complications, such as bradycardia and electrolyte imbalances, as well as elevated mortality (Mitchell & Crow, 2006). Given the detrimental effect of weight loss behaviors in AN, research is needed to clarify the proximal predictors of these behaviors, as they may serve as possible points of intervention.

Cognitive behavioral models of eating pathology suggest that body checking, which is conceptualized as a compulsive behavior involving increased attention and concern focused on a particular part of the body (e.g., weighing oneself, checking fat on joints and bones, monitoring thighs touching), may contribute to the onset and maintenance of pathological weight loss behaviors by highlighting the perceived imperfections in one's appearance (Fairburn et al., 2003; Mountford et al., 2006; Suda et al., 2013; Walker et al., 2018). Consistent with this theory, cross-sectional research conducted within non-clinical samples indicates that greater body checking is associated with higher levels of disordered eating behaviors (Haase et al., 2011), and longitudinal studies indicate that higher levels of body checking at baseline predict greater risk for the development of eating disorder symptoms four months later (Zaitsoff et al., 2020). In studies using clinical samples, individuals with eating disorders - including AN - display higher levels of body checking, compared to controls (Calugi et al., 2006). Further, greater body checking is associated with increased eating disorder severity within clinical samples (Mountford et al., 2006). Finally, among individuals with AN, increased body checking behavior is associated with increased risk for relapse following successful completion of inpatient/day hospital treatment (Carter et al., 2012). In sum, existing cross-sectional and long-term prospective research indicates that body checking may promote the onset of eating pathology, provide a marker of eating

disorder severity, and increase risk for relapse. Importantly, these forms of data-collection are not able to characterize the immediate impact of body checking on eating disorder symptoms, although information of this nature would help to inform theories of eating disorder maintenance and associated treatment approaches.

Ecological momentary assessment (EMA) can be utilized to examine the moment-to-moment temporal relationships between body checking and eating disorder behaviors. Broadly, this approach involves assessing individuals in their natural environment multiple times per day across the course of several days (Stone & Shiffman, 1994). Previous research using EMA among women with AN has demonstrated cross-sectional and prospective relationships between levels of body checking and engagement in eating disorder behaviors at the daily level (Lavender et al., 2013). More specifically, days characterized by higher levels of body checking also tended to be characterized by higher levels of dietary restriction. In addition, increased levels of body checking on one day predicted an increased likelihood of dietary restriction on the following day (Lavender et al., 2013). However, this study did not examine the momentary temporal relationships between body checking and other weight loss behaviors within a given day. That is, Lavender et al., 2013 did not examine whether engaging in body checking at one assessment point during the day was predictive of subsequent dietary restriction occurring within the next three to four hours (i.e., at the next signal). Further, Lavender et al., 2013 did not examine the relationship between body checking and engagement in other weight loss behaviors (e.g., exercise, self-induced vomiting). As individuals with AN frequently use a variety of dangerous and maladaptive behaviors to maintain their low weight, identifying the immediate antecedents of these behaviors holds strong clinical value. Further, clarifying the timescale in which body checking impacts weight loss behaviors (e.g., days, hours) may help to inform both theory and intervention.

Notably, the strength of the relationship between body checking and weight loss behaviors is likely to vary across individuals (Walker et al., 2018), and the identification of variables that moderate (i.e., increase or decrease) the strength of this association is likely to have important clinical implications, opening the door to potential targets for intervention. Many individuals with eating pathology, including those with AN, demonstrate a high degree of preoccupation with and ritualized behaviors related to food, eating, shape, and weight (i.e., eating-related obsessionality and compulsivity; Mazure et al., 1994; Steinglass et al., 2011). In other words, many individuals with eating disorders get “stuck” on negative thoughts about their eating, weight, or shape – and must then perform specific behaviors in order to address or alleviate these thoughts. Importantly, individuals with increased eating-related preoccupations and rituals demonstrate poorer treatment response and higher rates of post-treatment relapse (Halmi et al., 2002), suggesting that these preoccupations and rituals may serve to maintain the disorder. With respect to body checking, it is possible that individuals who experience higher levels of eating-related obsessionality and compulsivity may be at greater risk for engaging in eating disorder behaviors after body checking. That is, body checking may more readily precipitate compulsive weight loss behaviors among these individuals.

The goal of the current study was to build off of the EMA findings from Lavender et al., 2013, by examining the within-day temporal relationships between body checking and several weight loss behaviors within the same sample of women with AN. In addition, trait-level eating-related obsessionality and compulsivity was also tested as a moderator of these momentary relationships. It was hypothesized that body checking at one time point would predict an increased likelihood of engaging in weight loss behaviors at the next time point. In addition, it was hypothesized that the momentary relationships between body checking behaviors and later engagement in weight loss behaviors would be stronger among individuals with higher levels of eating-related obsessionality/compulsivity.

Methods

Participants

Participants in this study were 118 women, who were at least 18 years of age ($M_{\text{age}} = 25.3 \pm 8.4$ years; $M_{\text{body mass index}} = 17.2 \pm 1.0 \text{ kg/m}^2$) and met the criteria for the Diagnostic and Statistical Manual of Mental Disorders (4th Edition: *DSM-IV*; APA, 1994) AN ($n = 59$) or subthreshold AN ($n = 59$). Subthreshold AN was defined as meeting all of the *DSM-IV* criteria for AN with the following exceptions: (a) body mass index of 17.6 to 18.5 or (b) not meeting the amenorrhea criteria, or (c) not meeting the body image disturbance and intense fear of weight gain criteria. Previous examinations of these data indicated that full- and subthreshold AN participants did not significantly differ on most baseline measures of eating disorder pathology and comorbid psychological concerns (Le Grange et al., 2013). Originally, 601 participants were phone screened for eligibility, and 166 were selected for an additional in-person evaluation. Further evaluation resulted in 121 participants who met final eligibility criteria, who agreed to participate, and were enrolled in the study. Compliance rates within the EMA protocol were less than 50% for three participants and thus those data were excluded from the present analysis. Of the final 118 participants, seventy-three (61.9%) participants were diagnosed with AN restricting type and 45 (38.1%) with AN binge eating/purging type. Eighteen (15.2%) participants also met criteria for a lifetime diagnosis of obsessive-compulsive disorder, and of those participants eleven (9.3%) met criteria for a current diagnosis. The sample was predominantly Caucasian ($n = 114$, 96.6%). In addition, two individuals identified as African American (1.7%), one individual identified as multiracial (0.8%), and one individual identified as Guyanese-Indian.

Procedure

Data were collected between April 2006 and June 2010. The recruitment process was completed at three different sites throughout the Midwestern United States. Study approval was given by the institutional review board at each site. Recruitment was conducted via clinical, community, and campus advertisements. Individuals who met the phone screen criteria were invited to attend two study visits to complete a screening consisting of physical examination (for height and weight), laboratory tests (to assess medical stability), structured clinical interviews (to establish psychiatric diagnoses), and self-report measures. Research personnel provided training in the use of the palmtop computer (used for the EMA portion of the study) during the first study visit, after which participants completed two practice days (data not included in the final analysis) for feedback on compliance. Following the

practice procedure, participants were given the palmtop computers to be used during the two-week EMA protocol. The palmtops signaled participants at six times per day. More specifically, six “anchor points” that subdivided the day into six approximately equal blocks of time were identified: 8:30 AM, 11:30 AM, 1:50 PM, 4:30 PM, 7:10 PM, and 9:50 PM. Then, signal times were randomly distributed around these anchor points in a normal distribution with a standard deviation of 30 minutes to provide assessments evenly across the waking hours of the day. During these signal-contingent assessments, participants completed several self-report questions to assess their current or recent thoughts, emotions, and behaviors. In addition, participants completed event-contingent assessments following eating episodes (regular or binge) and AN behaviors (e.g., exercise, self-induced vomiting, skipping meals). Participants also completed interval-contingent assessments at the end of day to rate affect and report dietary restriction (e.g., not eating for eight hours, eating < 1200 kcal). Compensation for participation included \$100 per week for completing EMA assessments, and participants were given a bonus of \$50 for completing at least 80% of their signaled assessments.

Baseline Measures

Structured Clinical Interview for DSM-IV Axis I Disorders, Patient Edition (SCID-I/P; First et al., 1995).—The SCID-I/P is a semi-structured clinical interview that was used to assess diagnostic criteria for AN and subthreshold AN (including AN subtype), as well as comorbid psychiatric disorders. The interviews were delivered by trained assessors and recorded to assess inter-rater reliability. A secondary independent assessor rated current eating disorder diagnosis in a random sample of 25% of these interviews. Interrater reliability for a current AN diagnosis based upon a kappa coefficient was 0.93.

Yale-Brown-Cornell Eating Disorder Scale (YBC-EDS; Sunday et al., 1995).—The YBC-EDS is a semi-structured interview that assesses eating- and body-related preoccupations and ritualistic behaviors. The YBC-EDS administration is tailored towards an individual’s “target symptoms” and is focused on understanding the preoccupations and rituals associated with those symptoms. Global scores are created based upon the current time period (i.e., the past month) and the worst period occupied by these thoughts/behaviors. The global score for rituals/preoccupations experienced in the past month was used in the current study. Cronbach’s alpha coefficient for the global scale was 0.89.

EMA Measures

The EMA protocol assessed a variety of eating disorder behaviors along with other associated behaviors. Body checking was assessed using three items from the signal-contingent recordings: “I made sure my thighs didn’t touch”, “I checked my joints and bones for fat”, and “I weighed myself”. These items are consistent with the items assessing body checking in the Body Checking Questionnaire (Reas et al., 2022). Participants indicated whether or not they had engaged in each body checking behavior since the last EMA recording. For the current study, the three body checking items were aggregated into a single binomial variable where if any one of the items was endorsed, body checking was considered present. Notably, the frequency of body checking during the EMA protocol

was significantly correlated with one's vigilance about shape ($r = .39, p < .001$), assessed at baseline via the Eating Disorder Examination (EDE; Fairburn, 2008), supporting the convergent validity of this indicator. To assess reliability, we computed interclass correlation coefficient (ICC) for each behavior on the first and seventh day of the EMA protocol. The ICC for body checking reported on the first and seventh day of the EMA protocol was .55. This indicates that 55% of the variance in body checking on those days occurred between participants, while 45% of the variance ($1 - .55$) occurred within participants. Thus, although there were individual differences in body checking, there was also substantial variation in the likelihood of endorsing body checking on a given day within individuals.

At each signal-contingent recording, participants also reported whether or not they had engaged various weight loss behaviors. Five items were utilized in the current study. Each item was significantly correlated with responses given during the baseline EDE, providing evidence to support the convergent validity of these items: "I exercised" ($r = .54, p < .001$ with EDE exercise days), "I skipped a meal" ($r = .40, p < .001$ with EDE avoidance of eating), "I drank fluids to curb my appetite" ($r = .45, p < .001$ with EDE avoidance of eating), "I vomited" ($r = .37, p < .001$ with EDE vomiting episodes), and "I used laxatives for weight control" ($r = .50, p < .001$ with EDE laxative episodes). Further, the ICC's for weight loss behaviors reported on the first and seventh day of the EMA protocol suggested substantial between- and within-person variability: exercise (ICC = .31), meal skipping (.17), fluid intake (.41), vomiting (.77), and laxative use (frequency too low to estimate).

Statistical Analysis

Generalized linear mixed models (GLMMs) based on a binary logistic regression with logit link were used to examine how body checking (both person-centered and grand-centered means) at Time 1 predicted weight loss behaviors at Time 2 (Model 1), as well as the interaction between body checking and baseline eating-related obsessionality and compulsivity (YBC-EDS current global scores) in predicting weight loss behaviors (Model 2). Covariates in the models included body mass index and diagnostic subtype. Within-person effects (which indicate the temporal relationships between body checking at Time 1 and eating disorder behaviors at Time 2), were the primary effects of interest. The only missing data were on EMA assessments. Compliance with EMA signals averaged 87.3% (SD = 9.3%, range = 58% to 100%) and compliance with end-of-day recordings averaged 90.0% (SD = 17.3%, range = 24% to 100%). Analyses were based upon available data and missing EMA data were not imputed. All analyses were conducted using statistical package SPSS Version 28. Between-subject and within-subject effects for body checking were disaggregated following the procedures described by Curran and Bauer (2011).

Results

EMA Compliance

On average, participants responded to 87% (range = 58%–100%) of the signaled assessments, with 77% of signals being completed within 45 minutes. Of all the signal-contingent recordings ($N = 14,945$), 21.4% included reports of body checking, 0.5% included reports of laxative usage, 5% included reports of exercise, 5.5% included reports of

skipping a meal, 8.2% included reports of fluid intake to curb appetite, and 3.4% included reports of self-induced vomiting.

Body Checking and Exercise

Across the 14-day EMA protocol, participants reported engaging in body checking 27.14 times (range = 0–96, SD = 26.99), on average. Exercise was reported 6.28 times (range = 0–45, SD = 7.88), on average. Of the 118 participants, 10.2% did not report any body checking behaviors and 28% did not report any exercise throughout the study. In Model 1 (without the moderator variable), body checking was not a significant predictor of exercise behavior at the between- or within-subjects level (see Table 1 for all parameter estimates). In Model 2 (with the moderator variable), trait level eating-related obsessionality/compulsivity did not moderate this effect in the between- or within-subject models.

Body Checking and Laxative Use

On average, participants reported laxative use 0.62 times (range = 0–13, SD = 1.83) across the EMA protocol. Of the 118 participants, 78.8% did not report using laxatives for weight loss purposes throughout the EMA protocol. Body checking was not a significant predictor of laxative use behavior at the between- or within-subjects level. Additionally, trait level eating-related obsessionality/compulsivity did not moderate the between- or within-subjects effects.

Body Checking and Skipping Meals

On average, participants in this study reported skipping 6.98 meals (range = 0–34, SD = 8.01) throughout the entire 14-day EMA protocol. Of the 118 participants, 26% did not report skipping a meal throughout the study. Body checking was a significant predictor of skipping a meal at both the between- ($p = 0.001$) and within-subjects ($p = 0.002$) level. The between- and within-person effects were not moderated by eating-related obsessionality/compulsivity.

Body Checking and Fluid Intake

The frequency of fluid intake to curb appetite in the current sample was 10.42 (range = 0–58, SD = 12.34), on average. Of the 118 participants, 24% did not report ingesting fluid to curb appetite. Body checking was a significant predictor of fluid intake at both the between- ($p < 0.001$) and within-subjects ($p < 0.001$) level. The between- and within-person effects were not moderated by eating-related obsessionality/compulsivity.

Body Checking and Vomiting

Across the EMA protocol, participants reported engaging in self-induced vomiting an average of 4.26 times (range = 0–43, SD = 8.89). Of the 118 participants, 71% did not report any self-induced vomiting throughout the EMA protocol. Body checking significantly predicted vomiting at the between-subjects level ($p = 0.042$), but not at the within-subjects level. Between- and within-person effects were not moderated by eating-related obsessionality/compulsivity. However, compulsivity/obsessionality scores were independently associated with vomiting ($p = 0.006$).

Discussion

The primary aims of this study were to test the momentary (i.e., within-person) relationships between body checking and weight loss behaviors, as well as to examine trait-level eating-related compulsivity/obsessionality as a moderator of this relationship. Results indicated that when participants engaged in body checking, they were more likely to engage in weight loss behaviors related to dietary restriction (i.e., fluid intake to curb appetite and skipping meals) in the next three to four hours. These findings are consistent with results our team's previous EMA study using this sample, which found that body checking on one day was related to increased dietary restriction (i.e., not eating for eight waking hours, eating less than 1200 calories) on the same day and the following day (Lavender et al., 2013). Together, these findings suggest that body checking has both immediate and delayed effects on restrictive eating behaviors.

Notably, body checking at one time point was not related to subsequent use of compensatory behaviors such as laxative use, vomiting, and exercise at the next timepoint. It may be that these behaviors are only accessible during some hours of the day due to the need for privacy, extended periods of free time, or special equipment. Because of this, it may be more difficult to engage in these compensatory behaviors immediately following body checking. Consistent with this hypothesis, previous research indicates that rates of vomiting are typically highest in the evening when individuals are more likely to be at home or in a private space, while exercise is most likely to happen around lunch and dinner time, when individuals may have more time to invest in this activity (Lavender et al., 2016). Clinically, many patients do report that body checking contributes to compensatory behaviors such as vomiting and exercise. Therefore, it may be the case that the impact of body checking on these behaviors occurs on a more prolonged timescale than we assessed in this study (e.g., within the same day, rather than within the subsequent 3–4 hours).

Contrary to our hypotheses, eating-related obsessionality/compulsivity did not moderate the momentary relationships for any of the examined outcome variables. This finding suggests that the impact of body checking on subsequent dietary restriction behaviors is quite robust to individual differences in eating-related preoccupations and rituals. Notably, eating-related obsessionality/compulsivity is theorized to vary across time within a given individual (Sunday et al., 1995). Although this study utilized a trait-level measure of these experiences, it is possible that momentary within-person fluctuations in obsessionality/compulsivity may moderate the relationship between body checking and eating disorder symptoms. Further, individuals with AN exhibit high levels of perfectionism in which they seek exceptionally high standards and tend to judge themselves based on accomplishments (Bardone-Cone et al., 2007), as well as high levels of rumination in which they experience repetitive thoughts focused on negative emotional states (Smith et al., 2018). It could be that individuals who are highly perfectionistic, or who have difficulty disengaging from negative thoughts/emotions, may be more likely to engage in weight loss behaviors after body checking. Future research may examine whether momentary measures of compulsivity/obsessionality moderate the longitudinal effect of body checking on weight loss behaviors. Alternatively, researchers may explore trait- or state-level perfectionism and/or rumination as moderators of this relationship (Smith et al., 2021). Finally, we

note that trait obsessionality/compulsivity was related to an increased frequency of self-induced vomiting during the EMA period. This finding is consistent with some research indicating associations between elevated levels of compulsivity and increased frequency of self-induced vomiting among individuals with eating disorders (Thomas & Lovell, 2015).

There were several key strengths of this study including the use of a large clinical sample of participants with full threshold or subthreshold AN, and the use of EMA methodology that allowed us to investigate the temporal relationships between behaviors as they occurred in the natural environment. Limitations included a lack of gender and racial/ethnic diversity within the sample, with majority of the participants identifying as Caucasian (96.6%) and as female. Given this, the results from this study may not generalize to individuals who identify as male or racial/ethnic minorities. Importantly, previous cross-sectional research using community samples indicates that body checking behaviors commonly occur among individuals from diverse racial/ethnic backgrounds, with particularly elevated rates among Asian American women (White & Warren, 2013). Further, increased body checking is significantly associated with both eating pathology and maladaptive avoidance among racial/ethnic minorities (White & Warren, 2013). Therefore, inclusion of individuals from these minoritized backgrounds in future research on body checking is crucial. The reliance on self-report data represents an additional study limitation. Although the use of EMA reduces problems related to retrospective recall, it is still possible that some participants may underreport eating disorder behaviors due to embarrassment or shame. Finally, low base rates for some outcome variables (e.g., vomiting, laxative use) was a limitation as this may have reduced the statistical power to observe underlying effects. Importantly, the majority of participants in the current study were diagnosed with AN restricting type (61.9%), which likely contributed to the low base rate of purging behaviors. Therefore, future research including a larger sample of individuals with AN binge eating/purging type is recommended.

Ultimately, this research has important implications for the treatment of AN. Although we were primarily interested in the temporal relationships between body checking and weight loss behaviors, the between-subjects effects did indicate that individuals who reported more body checking over the course of the EMA protocol also tended to report more vomiting, dietary restriction, and use of fluids to curb appetite during those same two weeks. Further, during times when patients engaged in body checking they were at heightened risk for restricting their intake or fluid loading in the following hours. These results indicate that body checking is an important correlate and precipitant of weight loss behaviors among individuals who are already at a low weight. Clinicians are encouraged to help raise patients' awareness of these behaviors (which may be reinforcing and/or occur habitually), identify alternative behaviors that may be incompatible with body checking (e.g., removing scales from one's environment), and practicing strategies to help mitigate the increased risk for weight loss behaviors that follows body checking.

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Highlights

- After body checking, women with AN were more likely to restrict their intake.
- Trait obsessionality/compulsivity around eating did not impact this relationship.
- Trait obsessionality/compulsivity was related to more self-induced vomiting.

Table 1

Parameter Estimates for Multi-Level Models Examining Time 1 Body Checking as a Predictor of Time 2 Weight Loss Behaviors

Outcome	Model 1 without Moderator						Model 2 with Moderator					
	Within-Subjects			Between-Subjects			Within-Subjects *YCB-EDS			Between-Subjects *YCB-EDS		
	Coeff	SE	OR	Coeff	SE	OR	Coeff	SE	OR	Coeff	SE	OR
Exercise	0.08	0.12	1.08	-0.14	0.63	0.87	0.19	0.16	1.21	-0.91	0.89	0.40
Laxative Use	-0.08	0.21	0.93	0.56	0.32	1.75	-0.10	0.18	0.90	0.01	0.31	1.01
Skipping Meals	0.32	0.10	1.37**	1.84	0.57	6.29**	0.03	0.14	1.03	-1.08	0.82	0.34
Fluid Intake	0.40	0.09	1.49***	2.96	0.56	19.21***	0.12	0.13	1.13	-1.19	0.85	0.31
Vomiting	0.12	0.13	1.11	1.57	0.77	4.74*	-0.23	0.223	0.79	-1.71	1.17	0.18

Note. YCB-EDS = Yale-Brown-Cornell Eating Disorder Scale Current Global Score; Coeff = log(odds ratios); SE = Standard Error; OR = Odds Ratio.

*
 $p < .05$.

**
 $p < .01$.

 $p < .001$