



Emotion regulation difficulties and dietary restraint independently predict binge eating among men

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Abstract

Purpose Research on eating disorder symptoms among men is growing, but there still are few specific models of disordered eating. The aim of the current study is to expand the literature on male eating behavior by investigating how negative affect can lead to binge eating and overeating through possible mediators, i.e., emotion regulation difficulties and dietary restraint, both separately and together in an integrative model.

Methods Altogether 104 men (mean age 27.3, SD = 8.02; BMI 24.2, SD = 2.92) participated in the study using ecological momentary assessment to collect data on negative affect, the urge to restrict, and the occurrence of binge eating and overeating episodes. Self-report questionnaires were used to measure emotion regulation difficulties and eating disorder symptoms.

Results We found that both emotion regulation difficulties and the urge to restrict mediated the effect of negative affect on binge eating in separate models as well as in an integrated model. However, emotion regulation difficulties did not predict the urge to restrict in the joint model. These models did not predict overeating, indicating the pathological nature of binge eating.

Conclusions Our data suggest that negative emotions themselves do not lead to binge eating, but manifest through emotion regulation difficulties and dietary restraint. The results indicate that emotion regulation and restraint play a role in precipitating binge eating among men. However, the emotion regulation and restraint pathways seem to operate independently from one another. Our study also supports the differentiation of overeating and binge eating, as these seem to have different etiologies.

Level of Evidence Level V, cross-sectional descriptive study.

Keywords Binge eating · Overeating · Men · Emotion regulation · Dietary restraint

Introduction

Binge eating (BE) is the most common eating disorder (ED) symptom among men and women [1]. In the existing literature, the prevalence rates of at least weekly episodes of BE among men vary, ranging from .9 to 7.8% [2, 3], and the prevalence of ED symptoms is growing among men [2].

BE is associated with higher negative affect (NA) and overall distress [4–6]. NA is considered to be a risk factor

and a maintaining factor for disordered eating and has been shown to precede BE [7, 8]. In a similar vein, among female individuals with BE and binge eating disorder (BED), significantly lower mood has been found on binge days versus non-binge days [8, 9]. This is in accord with emotion regulation (ER) theories of BE, which posit that BE functions as a maladaptive strategy for coping with negative emotions [10]. Many recent studies have shown an association between ER difficulties and disordered eating such as BE among women [11, 12] and men [13–15]. Similarly, a study on participants with BED found that ER difficulties interacted with depressive mood in predicting BE frequency [16].

Another prominent theory of BE is the restraint model, which implies that individuals that engage in dietary restraint are more vulnerable to BE because of their rigid rules and “all-or-nothing” thinking [17]. Indeed, restrained eating has been found to be associated with BE in many empirical studies and is considered a risk factor for BE [18]. Furthermore, it is speculated that in restrained individuals,

This article is part of topical collection on Males and eating and weight disorders.

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any distraction—internal or external—may interfere with the cognitive control that is applied for dietary restraint [17]. These potential distractors can include emotions, especially negative ones. Studies have shown that restrained eaters increase food intake in response to negative emotions [17]. Individuals with both high NA and high restraint have been found to exhibit more BE [19]. Stice's dual pathway model, which addresses NA and dietary restraint pathways leading to bulimic behavior, has received some (but inconsistent) support in research on women [20, 21].

Compared to BE, overeating (defined as consuming a large amount of food in a brief period of time without experiencing loss of control) has received less attention in the literature. Overeating and BE seem to lie on the continuum of pathological eating, with the latter being more pathological [22]. It has been posited that loss of control, an integral aspect of BE, is a significant predictor of eating disorders and mental health issues in general [23]. However, overeating was found to be associated with greater impairment in most domains of life, regardless of the presence or absence of loss of control [24], and with a high rate of worsening of eating disorder symptoms, e.g., developing BE [25].

Although the number of studies examining disordered eating behavior among men is slowly increasing, most studies are conducted on predominately female clinical samples, hindering inferences on male eating behavior in general. As the ER and restraint theories are well researched among female samples, there is a need to assess these associations among men, as well. In addition, there are few integrative models that incorporate both restraint and ER aspects in predicting BE. A recent study showed an association between restrained eating and ER difficulties in a non-clinical population, suggesting that restrictive eating may also function as an emotion regulation strategy [26]. Thus, we aimed to assess the associations between these constructs in predicting BE and overeating.

Study aims and hypotheses

We aimed to assess how NA can lead to BE and overeating among men by testing two of the most discussed pathways—ER difficulties and dietary restraint. We hypothesized that: (1) NA predicts both BE and overeating, (2) ER difficulties mediate the effect of NA on binge eating, (3) the urge to restrict mediates the effect of NA on BE, and (4) NA predicts BE through both ER difficulties and the urge to restrict in an integrated model (i.e., a model with two mediators). We also tested this model for predicting overeating. BMI was added as a covariate.

Method

Sample characteristics

To gain more statistical power, the data were merged from two separate but methodologically equivalent studies conducted in 2014–2015 (61 men) and 2017 (46 men). Part of the data of the first study, which was conducted both in men and women, has been published by Kukk and Akkermann [27]. The two samples did not differ in terms of mean number of overeating and BE episodes per day, difficulties in ER, eating disorder symptoms (as measured by self-report measures described below), and demographic variables thus justifying the merge. The preliminary sample consisted of 107 men; however, three participants had missing data and were thus removed from further analysis, resulting in a final sample of 104 men.

The mean age of the participants was 27.3 (SD = 8.02, range 17–60). Participants' mean BMI was 24.2 (SD = 2.92, range 17.79–34.72), with 67.3% of the participants with BMI in the normal range (18.5–25). The study was approved by the Research Ethics Committee of the University of Tartu.

Procedure

Participants were recruited via mailing lists, social media and advertisements on local campuses and cafeterias in Tartu and Tallinn, Estonia. Participants signed up for the study via a web-based research portal of the Institute of Psychology, University of Tartu, where they filled in the self-report questionnaires. Next, they scheduled an appointment with the study coordinator in which they were informed about the details and instructions of the subsequent EMA study. The definitions of overeating, binge eating, and loss of control were also explained to the participants.

Measures

Body mass index

Body mass index (BMI) was calculated based on self-reported weight and height. BMI was calculated as body mass in kg divided by the squared height in meters.

Eating Disorders Assessment Scale (EDAS) [28] is a 29-item self-report scale measuring ED symptoms. It was used for assessing ED symptoms in association with real-time overeating and BE in the current study. It comprises four subscales: restrained eating, binge eating, purging, and preoccupation with body image and body weight. Items were answered on a 6-point scale (from “never” to “always”). The scale has good psychometric properties and

internal consistency, for the current sample was $\alpha = .91$ for the whole scale. Construct validity of the scale was confirmed by strong correlations with the EDI-2 subscales that measure ED symptoms.

Difficulties in Emotion Regulation Scale (DERS) [29] is a self-report questionnaire designed to assess different aspects of ER difficulties. The scale comprises six subscales: non-acceptance of emotional responses (non-acceptance), difficulties engaging in goal-directed behavior (goals), impulse control difficulties (impulse control), lack of emotional awareness (nonawareness), limited access to ER strategies (limited strategies), and lack of emotional clarity (lack of clarity). The Estonian version consists of 34 items, and the internal consistency of the total DERS score in the current sample was $\alpha = .89$.

Ecological momentary assessment

The data on eating behavior and emotional experience were collected with ecological momentary assessment (EMA). In the first study, the EMA portion was programmed and conducted with palmtop computers using freeware software, iESP (Lisa Feldman Barrett & Daniel Barrett, <http://www.experience-sampling.org/esp/>), and the study period was 3 days. The second study was conducted using a freeware smartphone app, PACO (Personal Analytics Companion, www.pacoapp.com), and the study period was 7 days. In both studies, the devices were programmed in the same way, using semi-random signals 7 times a day (from 8:30 am to 23:05 pm). The EMA questions used in the current paper were the same for both studies. Upon receiving the signal, participants were asked to answer questions regarding their whereabouts, situational aspects (neither were analyzed in the current paper), eating behavior, and emotional experience. Participants were asked about their overeating (“Have you had a binge eating episode after the last signal?”—“yes”/“no”); if “yes”, they were asked about loss of control (“During that episode did you experience loss of control over eating?”—“yes”/“no”). The presence of loss of control was used to differentiate BE and overeating in further analysis. The urge to restrict was measured with one item (“To what extent do you feel the urge to restrict your food intake?”) on a 3-point Likert-type scale (“not at all” to “to a large extent”). The momentary emotions and related aspects were assessed on a 4-point Likert-type scale in the first study and a 9-point Likert-type scale (“not at all” to “a large extent”) in the second study. The emotion ratings were standardized for further analysis. Only negative emotions were used (see below) in the current paper due to its objectives. For more details on the EMA questionnaire, see (citation removed for blind review). The EMA compliance in this study was moderate—71.3%.

Data analysis

The study was cross-sectional. The dependent variables—BE and overeating—represent mean binge eating and overeating episodes per day. Binge eating was registered if participant reported overeating and loss of control; overeating was registered if loss of control was not reported (see the items above). NA was aggregated based on the following emotions assessed via EMA during the study period: *boredom, sadness, shame, loneliness, guilt, irritation, tedium, anxiousness, anger, and disappointment*. Due to the different point ranges of the Likert-type scales used in the two studies, EMA emotion ratings were standardized to *z*-scores. The urge to restrict was measured via EMA (as described above) and represents a mean score of the study period.

Preliminary analysis revealed that the variables and residuals were not normally distributed as expected with data with psychopathological variables. Thus, the mean overeating episodes per day, DERS total score, urge to restrict, and NA were log-transformed, and the mean BE per day was root-squared prior to standardization for regression analysis. There were a few outliers in most of the used variables. Analyses were conducted with and without outliers, and the results were similar on both occasions, so we decided not to omit the outliers from further analysis.

Pearson’s correlation analysis was used to assess general associations between overeating/BE and ER difficulties as well as indicators of emotional experience. Multiple regression analysis and the PROCESS add-on by Andrew Hayes [30] version 2.13.2 for SPSS were used for modeling and for testing mediation effects between the variables. BMI was added to the models as a covariate. For the integrated model, PROCESS Model 6 was used (model with two mediators), and both DERS and the urge to restrict were added as mediators. We used bootstrap analysis on all indirect effects with 5000 bootstrap samples and 95% bias-corrected confidence intervals (CI). All data analyses were conducted using IBM SPSS version 23.

Results

Descriptive statistics

55.4% of the participants experienced at least one overeating episode, and 26.9% of the participants experienced at least one BE episode during the study period. On average, participants reported .33 (SD = .50, range 0–3) overeating and .16 (SD = .32, range 0–3) BE episodes per day. Mean scores of DERS and EDAS subscales and correlation coefficients between BMI, DERS, and EDAS subscales, momentary urge to restrict eating, NA, BE, and overeating episodes are reported in Table 1.

Table 1 Mean values and correlation coefficients between BMI, DERS, EDAS, momentary urge to restrict, negative affect, and binge eating and overeating episodes

	Correlation coefficients		Mean	SD
	Overeating	Binge eating		
BMI	.234*	.198*	24.2	2.92
DERS total score	-.012	.421**	70.75	17.89
DERS Goals	-.067	.263**	17.39	6.24
DERS Lack of clarity	-.026	.323**	14.64	4.44
DERS Impulse control	.020	.389**	6.41	2.90
DERS Non-acceptance	-.056	.367**	7.39	3.42
DERS Nonawareness	-.007	.067	12.47	4.32
DERS Limited strategies	.002	.405**	12.45	5.31
EDAS total score	.256**	.606**	30.95	17.40
EDAS Restraint	.184	.359**	10.16	6.38
EDAS Binge eating	.155	.544**	11.34	7.11
EDAS Purging	.052	.498**	.42	1.06
EDAS Preoccupation	.269**	.478**	9.03	7.51
EMA measures				
Mean urge to restrict	.353**	.372**	1.19	.31
Mean NA	.107	.200*		

Mean NA is 0 due to standardization

DERS Difficulties in Emotion Regulation Scale, EDAS Eating Disorder Assessment Scale, EMA ecological momentary assessment, NA negative affect

* $p < .05$, ** $p < .01$

Binge eating models

Preliminary analysis

We tested individual regressions of the mean negative affect, DERS, and the urge to restrict on BE. Negative affect predicted BE, $R^2 = .040$, $b = .070$, $t(102) = 2.06$, $p = .042$.

Individually, the urge to restrict was the best predictor of binge eating, $R^2 = .23$, $b = .272$, $t(102) = 5.56$, $p < .0001$, while DERS predicted BE significantly as well, $R^2 = .16$, $t(102) = 4.45$, $p < .0001$.

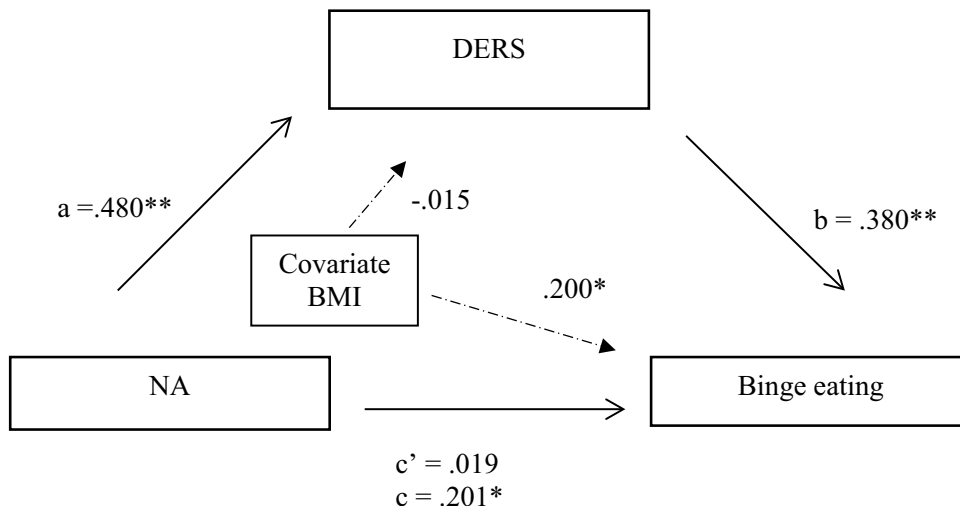
Emotion regulation model

The regression of NA on BE, controlling for BMI, was significant, $b = .070$, $t(101) = 2.10$, $p = .038$. Controlling for BMI, NA significantly predicted DERS, $b = .111$, $t(101) = 5.50$, $p < .0001$. The regression of the mediator DERS on BE, controlling for NA and BMI, was significant as well, $b = .57$, $t(100) = 3.70$, $p = .001$. Finally, controlling for DERS, NA was no longer significant in predicting BE confirming the full mediation, $b = .132$, $t(100) = 1.26$, $p = .212$. The model was significant, $R^2 = .20$, $F(100) = 8.32$, $p < .0001$. The Sobel test indicated that the indirect effect was significant, $z = 3.04$, $p = .002$. The indirect effect was .064 (standardized coefficient .186), and bootstrapped 95% CI .020–.113. The proportion of indirect effect relative to the total effect was $P_M = .914$. The regression coefficients are presented in Fig. 1.

Restraint model

Controlling for BMI, NA significantly predicted the proposed mediator variable urge to restrict, $b = .10$, $t(101) = 5.18$, $p < .0001$. The urge to restrict predicted BE, controlling for NA and BMI, $b = .60$, $t(100) = 3.64$, $p < .0001$. The regression of NA on BE was no longer significant when controlling for the urge to restrict and BMI, $b = .01$, $t(100) = .31$, $p = .756$. The Sobel test indicated that the indirect effect was significant, $z = 3.42$, $p < .001$. The size of the indirect effect was .059 (standardized coefficient .170) with bootstrapped 95% CI .019–.099. The proportion

Fig. 1 Mediation model of negative affect and emotion regulation difficulties on binge eating in men. Standardized regression coefficients. * $p < .05$, ** $p < .01$, c' = direct effect, c = total effect



of indirect effect relative to the total effect was $P_M = .84$. The regression coefficients are presented in Fig. 2.

Integrated model

The two above-mentioned mediation effects remained significant; the indirect effect size of NA on BE via DERS was .066 (standardized coefficient .191), and the indirect effect size of NA on BE via urge to restrict was .065 (standardized coefficient .186), total indirect effect .128 (standardized coefficient .368). However, DERS did not predict urge to restrict, and thus, there was no mediation effect through both mediators. The regression coefficients are presented in Fig. 3.

Overeating models

Preliminary analysis indicated that NA did not predict overeating significantly, $R^2 = .028$, $b = .049$, $t(102) = 1.70$,

$p = .092$, as neither did DERS, $b = .007$, $t(102) = .006$, $p = .953$. In a single regression, both the urge to restrict and BMI predicted overeating significantly: $R^2 = .183$, $b = .315$, $t(102) = 4.77$, $p < .0001$, and $R^2 = .06$, $b = .025$, $t(102) = 2.55$, $p = .012$, respectively. Thus, mediation analyses with DERS and the urge to restrict were not conducted, as the main assumption (NA predicting overeating) was not met. The urge to restrict predicted overeating significantly while controlling for BMI, $R^2 = .21$, $b = .290$, $t(101) = 4.36$, $p < .0001$, but BMI was no longer significant while controlling for the urge to restrict, $b = .017$, $t(101) = 1.83$, $p = .070$.

Discussion

The aim of the current paper was to expand the research on male eating behavior by investigating how NA can lead to BE through ER difficulties and restraint. We also aimed to integrate these aspects in a joint model predicting BE. In

Fig. 2 Mediation model of negative affect and urge to restrict on binge eating in men. Standardized regression coefficients. * $p < .05$, ** $p < .01$, c' = direct effect, c = total effect

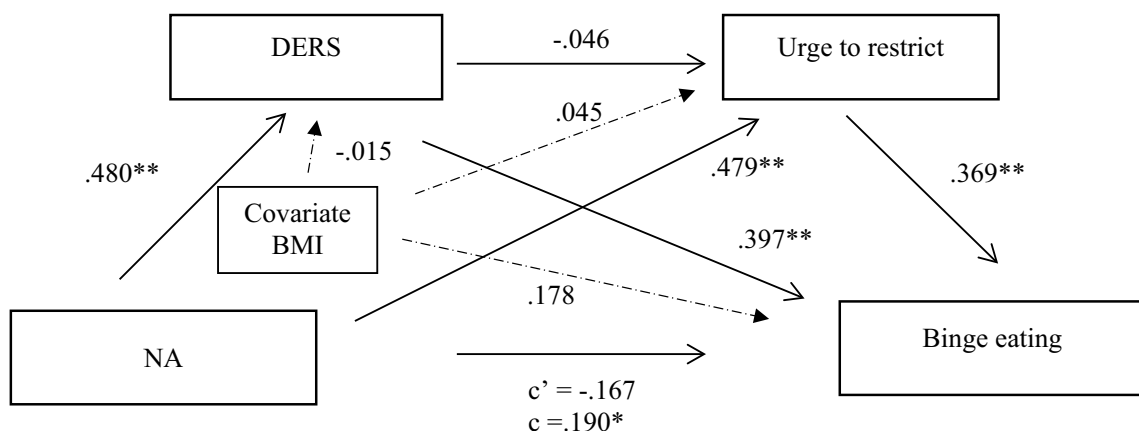
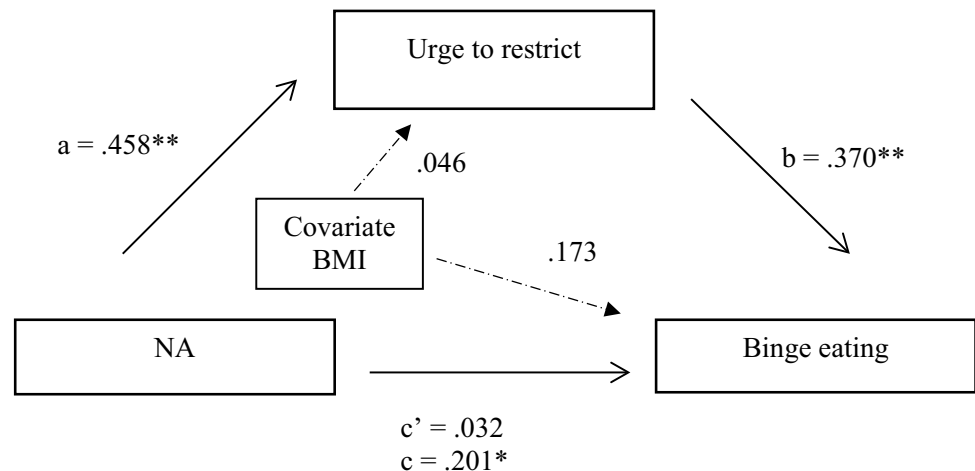


Fig. 3 Integrated model of emotion regulation and the urge to restrict. Note: standardized regression coefficients. * $p < .05$, ** $p < .01$, c' = direct effect, c = total effect

addition, we wanted to test these associations in predicting overeating, as these seem to be different yet associated constructs.

As any overeating (with or without loss of control) is associated with greater distress [24], we first hypothesized that NA predicts both BE and overeating. This hypothesis was confirmed regarding BE, which is in line with current research indicating a strong link between BE and NA [8]. It has been consistently found that NA increases before BE [7, 31], implying the need to regulate one's emotions. With this in mind, we hypothesized that ER difficulties mediate the effect of NA on BE. There was indeed a full mediation effect of DERS. Previous studies have also found that NA and ER difficulties are associated with disordered eating (e.g., BE) in female and male samples [13], while the mediation effect has not previously been explicitly assessed. However, Kenny et al. [16] found that depression moderates the effect of ER difficulties on BE in a female BED sample. Our data suggest that negative emotions manifest through ER difficulties, meaning that if one experiences high levels of NA, one might have difficulties regulating emotion, thus possibly leading to a BE episode. A prospective study by Spoor et al. [6] conducted among young females noted that BE is not so much related to future depressive symptoms but rather seems to be associated with attempts to regulate one's mood. This is in line with our results as well as the ER theory, by which NA leads to BE as an attempt to regulate one's emotions [10].

Another association that we aimed to assess was the effect of dietary restraint on BE. The hypothesis that the urge to restrict (which was highly correlated with the EDAS restraint subscale) mediates the effect of NA on BE was also confirmed, as mediation analysis indicated a significant indirect effect on BE. This corroborates the premise that high levels of negative emotions can lead restrained eaters to BE, although the specific mechanisms are unclear. It may be that strong emotions interrupt the cognitive control used for dietary restraint [17]. Another explanation is that dietary restraint and attempts to reduce NA diminish self-control, which in turn can lead to maladaptive behavior (e.g., BE) [24], which is in accordance with the resource depletion model of self-control [32]. Indeed, a recent study by Evers et al. [31] concluded that restrained eaters are especially prone to eat in response to (negative) emotions. However, Smith et al. [4] found among obese individuals that state NA predicted subsequent decreases in restraint intentions. Nevertheless, these conflicting results may be partly due to the study samples (young females and obese individuals, respectively) and research methodology (prospective versus momentary associations) and may not be generalizable to men in general.

We also aimed to integrate both models to assess how ER difficulties and restraint interplay in predicting BE and

overeating. The above-mentioned individual mediation effects remained significant, but there was no mediation effect through both mediators, i.e., ER difficulties did not mediate the effect of NA on the urge to restrict. These results are somewhat contrary to the findings that restrictive eating is associated with ER difficulties as restraint could be used as a strategy to regulate one's emotions [26]. However, previous studies have not taken into account other aspects such as NA in predicting BE, which may override the associations. Our results suggest that the ER and restraint pathways are relatively independent from one another, meaning that there are different trajectories through which negative emotions can lead to BE.

We tested the above-mentioned mediation models in predicting overeating as well. As NA did not predict overeating, the assumptions for analyzing mediation effects were not met. Similarly, correlation analysis indicated that overeating is not associated with ER difficulties and ED symptoms except with preoccupation with body image and body weight, while BE was highly correlated with almost all measured aspects. These results support the general notion that overeating is less pathological, as the loss of control aspect of BE has been found to be associated with specific ED pathology and general psychopathology [23] as well as with ER difficulties [33]. However, we did find that the momentary urge to restrict predicted overeating, and it explained a significant proportion of the unique variance. Our results suggest that overeating is still linked, albeit to a lesser degree, to eating disorder symptoms (namely, restrained eating), indicating the need to address subclinical aspects of disordered eating for prevention.

Strengths and limitations

The biggest strength of our study was the use of a male sample of considerable size. The study contributes to the limited literature on eating behavior in men by integrating restrained eating and ER aspects in predicting BE. Although the research on ED symptoms among men is expanding, there is still little research investigating the mechanisms underlying BE and overeating.

We used EMA to collect data on overeating and BE, as well as on the urge to restrict, which we expected to be more reliable than retrospective questionnaires. However, we still relied on self-reported data, potentially biasing the results. Another methodological challenge was that the data were gathered from two related studies, but the preliminary analysis showed no significant differences in demographic data nor in the variables used. Arguably, we did not utilize the full potential of EMA, as we used the averaged data of these measures due to our aim to assess the overall tendencies between these aspects above and beyond temporal associations. To make causal inferences, hierarchical models

should be used to take into account momentary associations between the variables. A study on a subsample of the current study using hierarchical statistical analysis has previously been published [27].

The study was conducted in a non-clinical sample, because we aimed to assess eating pathology in the general population, as BE can occur in otherwise healthy individuals. We believe that it is important to address subclinical levels of disordered eating, as it presents a potential risk factor for developing future ED or overweight. Moreover, research suggests that there may be specific associations between affect, restraint and ER difficulties in different subgroups (i.e., participants with restrained eating and overweight) [34] that need to be addressed in further studies among men.

Conclusion and further implications

Our study provides additional evidence for the important role of ER and restraint in predicting binge eating, and it extends the literature by addressing these aspects in a male sample. We found that ER difficulties and the urge to restrict mediated the effect of NA on binge eating but not overeating. ER difficulties did not predict urge to restrict. Overeating was associated with the urge to restrict but not with NA or ER difficulties. The results have implications for the development of treatment and prevention strategies as ER difficulties and dietary restraint could be subjects of intervention.

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Compliance with ethical standards

Conflict of interest The authors declared no potential conflicts of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the University of Tartu ethics committee and with the 1964 Helsinki Declaration and its later amendments.

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

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