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## Relations of dietary restraint and depressive symptomatology to loss of control over eating in overweight youngsters

Lien Goossens · Caroline Braet · Guy Bosmans

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**Abstract** This study investigated the dietary restraint and depression pathway to loss of control over eating among a sample of overweight youngsters based on the assumptions of the extended cognitive behavioural theory for bulimia nervosa. The children's version of the eating disorder examination interview and the children's depression inventory were administered to 350 overweight youngsters (with a mean age of 13.30 years old). Structural equation modelling indicated that the over-evaluation of eating, weight and shape was significantly associated with dietary restraint, which in turn was significantly associated with loss of control over eating. Evidence was also found for a direct pathway between depressive symptoms and loss of control over eating. It can be concluded that in general, the main components to maintain the bulimic cycle in eating disordered patients operate in a similar way to maintain loss of control over eating in overweight youngsters.

**Keywords** Eating disorders · Overweight · Restraint · Depressive symptomatology

### Introduction

Prevalence rates of paediatric overweight are reaching epidemic proportions [39, 42]. Paediatric overweight is associated with severe medical [1, 27] and psychosocial consequences [51] as well as with an increased risk for

adult obesity [24, 60] and the development of eating disorders (EDs) [20, 22, 45].

Recent studies have shown that a substantial part of overweight youth report loss of control over eating (LC), which is considered the most important feature of binge eating [30, 41, 53], with prevalence rates of LC ranging up to 36% among treatment seekers [16, 28, 32]. However, to date, little is known about which youngsters are most vulnerable to develop LC. Studying underlying mechanisms of LC is of clinical importance because research has shown that LC predicts the future onset of obesity [49] and weight gain [23, 54]. Also, subclinical ED symptoms (like LC) may be a precursor of full-blown EDs later on [45]. Especially in overweight youngsters, early identification of those who are most vulnerable to LC seems warranted because in these youngsters, the burden of suffering from (symptoms of) an ED may add to the burden of suffering from overweight [29].

The extended cognitive behavioural theory of eating disorders (CBT-E)

Theories designed to understand the development and maintenance of binge eating among ED samples may serve as an adequate background for understanding LC in (overweight) youth. According to the extended cognitive behavioural theory (CBT-E) [17, 21], the over-evaluation of eating, weight and shape constitutes a central role in the development and maintenance of bulimic symptoms. More specifically, this core psychopathology promotes efforts to restrict eating. As part of this dietary restriction, rigid dieting rules are followed. In a moment of weakness, it becomes unbearable to hold onto those rigid rules and eventually, this may lead to binge eating which in turn may again promote dietary restraint afterwards. In that way, a

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highly distinctive pattern of eating develops in which sustained dietary restraint is repeatedly punctuated by episodes of binge eating.

Another possible pathway to binge eating which is also incorporated in the CBT-E highlights the importance of the concept mood intolerance [21]. According to this pathway, binge eating can also directly result because of a person's difficulty to cope appropriately with intense (mainly adverse) mood states such as anger, anxiety and depression. Although evidence coming from adult samples supports both pathways to binge eating [19, 45, 59], little is known about the value of this model in paediatric overweight samples.

### Overweight youth

Some aspects of the CBT-E have already been tested separately in overweight children and adolescents but findings are mixed, possibly due to the heterogeneity within the overweight population. In overweight youngsters who are exclusively treatment seeking, evidence supporting the affect regulation pathway is found, especially with regard to the role of symptoms of depression [16, 32] and anxiety [28], whereas in exclusively non-treatment seeking samples, less evidence is found for this affect regulation pathway [52] and more evidence is obtained supporting the dietary restraint pathway [53]. Thus, it may be assumed that depending on the compilation of the overweight sample, different pathways may explain LC. To our knowledge, no study investigated the competitiveness of dietary restraint versus depressive symptomatology in a more representative sample of both non-treatment seeking and treatment seeking overweight youngsters.

With regard to the influence of the core psychopathology studies consistently found that overweight youngsters experiencing LC reported more concerns about eating, weight and shape compared to those who do not experience LC [16, 28, 32, 52]. These results provide preliminary support for the importance of this over-evaluating system among overweight youth and indicate that, in line with adult research [34, 35], being over-concerned about one's eating, weight and shape may not simply reflect concerns commensurate with being overweight but seems to be an important clinical variable associated with both eating pathology and depression. Nevertheless, among overweight youngsters, the questions still remains whether this over-evaluating system is related to LC through the restriction of one's food intake, as it was proposed by the CBT-E [21], or also via the experience of depressed emotions?

### The present study

The current study aimed at gaining a clear insight into the development of LC among overweight youngsters by evaluating two important pathways specified by the CBT-E

[21]. More specifically, we tested a model proposing (1) a relationship between the core psychopathology (i.e. over-evaluation of eating, weight and shape), dietary restraint and LC and (2) a relationship between depressive symptoms and LC.<sup>1</sup>

To our knowledge, this is the first study using structural equation modelling to evaluate the value of these two proposed mechanisms in one and the same model in overweight youth. Based on the assumptions of the theory, it is hypothesized that after taking into account possible differences between treatment seekers and non-treatment seekers, direct associations exist between the core psychopathology and restraint, between restraint and LC and also between depressive symptoms and LC.<sup>2</sup>

## Methods

### Sample of the present study

The sample of this study were 350 overweight children and adolescents (277 were treatment seekers, and 73 were non-treatment seekers); 141 boys (40.3%) and 209 girls (59.7%); ages ranged between 8 and 18 years ( $M = 13.30$ ,  $SD = 2.17$ ). Exclusion criteria in this study were mental retardation and the presence of developmental syndromes. All participants were diagnosed as being primary overweight [body mass index (BMI) >the 85th percentile for age and sex].

### Measures

*Dietary restraint, LC and the over-evaluation of eating, weight and shape: ChEDE*

The children's version of the eating disorder examination (ChEDE) [8] is a standard investigator-based interview measuring the severity of the core psychopathology of

<sup>1</sup> Since our inpatient sample has to complete a rather large standard battery of several assessment instruments at the start of their treatment, we were limited with regard to adding extra instruments to the assessment battery. Although we are aware that the concept of mood intolerance encompasses a broad range of adverse mood states, we opted to focus exclusively on examining the role of depressive symptoms (further described as the 'depression pathway').

<sup>2</sup> It needs to be remarked that it was not the purpose of the present study to test the entire CBT-E [21]. The CBT-E entails some other additional mechanisms as well (such as the role of perfectionism and core low self-esteem). However, in the present study, our main focus was reserved on those variables that, according to the theory, appear to be directly associated with binge eating. Also, we are aware that all variables that were investigated in the present study are intrapersonal and that interpersonal variables (such as adverse life events) may also contribute to eating pathology.

EDs and generating ED diagnoses. The ChEDE is based on the adult EDE [18] and is modified by experts in the field of EDs in children in collaboration with the authors of the original EDE. A translation of the ChEDE was designed for use in populations of Dutch children [15]. The ChEDE can be administered from children as young as 8 years old and contains four subscales designed to provide a profile of individuals in terms of four major areas of ED psychopathology: restraint, eating concern, shape concern and weight concern. In addition, the ChEDE measures three forms of overeating: objective bulimic episodes (OBE; the ingestion of a large amount of food accompanied by LC), subjective bulimic episodes (SBE; the ingestion of an amount of food that is considered large by the subject but not by others, accompanied by LC) and objective overeating (OO; the ingestion of a large amount of food without LC) episodes. The ChEDE also measures four methods of weight control: self-induced vomiting, laxative misuse, diuretic misuse and intense exercising. Studies confirmed the validity and reliability of this instrument [14, 58]. In the current study, alpha coefficients for the subscales were adequate (0.57 for restraint, 0.57 for eating concern, 0.63 for weight concern and 0.83 for shape concern). Based on the recommendations by Marcus and Kalarchian [41], children and adolescents in this study were categorized as having experienced LC when they mentioned at least one episode of OBE or SBE over the last 3 months.

#### *Depressive symptoms: CDI*

The children's depression inventory [38], translated in Dutch by Timbremont and Braet [55], assesses cognitive, affective and behavioural symptoms of depression in youth (between the age of 8 and 17 years). The questionnaire contains of 27 items. Although Kovacs [38] describes five factors or subscales within the English CDI, second order factor analyses reveal only one coordinating factor (referring to one general underlying construct of depression). Moreover, up until now, little research has been conducted on the reliability and validity of the different subscales. Because of this limited empirical evidence, the Dutch version of the CDI [55] and its recently revised manual [57] does not distinguish between subscales, and only uses one general score for depressive symptomatology. This CDI total score has relatively high levels of internal consistency, test–retest reliability and predictive, convergent, discriminant and construct validity [11, 55, 56]. Research provides support for the usefulness of the CDI as a screening tool for detecting depressive disorders in children and adolescents [56]. In the present study, the coefficient alpha for the CDI total score was 0.86.

#### *Weight status: adjusted BMI*

Weight and height were measured using calibrated instruments. The BMI (weight/height<sup>2</sup>) was determined for each child. In order to make BMI comparisons between overweight children of different ages, this study uses the adjusted BMI [(actual BMI/percentile 50 of BMI for age and sex) × 100]. The 50th percentiles of the BMI for age and sex are based on normative data [26]. Furthermore, to standardize BMI across (international) samples, BMI standard deviation (BMI-*z*) scores were calculated according to the Centres for Disease Control (CDC) and Prevention 2000 standards [42] and the percentage of participants classified as overweight and obese on the basis of the IOTF BMI cut-off points [10] was determined.

#### *Procedure*

Overweight treatment seekers were recruited through two waves. In the first wave of data gathering, all youngsters who were enlisted on an inpatient treatment waiting list in 1999 and who met inclusion criteria ( $n = 162$ ) were asked to participate and they were visited at their homes where all measures were administered. In a second wave, participants who entered the clinic between January 2005 and July 2006 were invited. Those who met inclusion criteria ( $n = 115$ ) were questioned during the first week of their treatment (for a full description of the program; see [4]).

In addition to the treatment seeking subsample, we also created a subsample of overweight non-treatment seekers. These youngsters were recruited through advertisements in healthcare magazines and via school mailings. The research was described as a study into the psychological well-being of youngsters with 'a bigger size'. These youngsters ( $n = 73$ ), all meeting the general inclusion criteria, were eligible when at the time the study took place, they did not seek or follow any kind of inpatient or outpatient treatment for their overweight (defined as a treatment in order to lose weight with at least the help of a dietician). All participants in the non-treatment seeking sample were aware that they would not receive any kind of treatment as part of the study protocol and they were seen at the university where they completed all assessments. The present study was approved by the university research ethics committee. Informed consent was obtained from both the youngsters and their parents.

#### *Statistical analyses*

Results were expressed as a mean (SD) or percentage of the sample. To determine group differences between the treatment seekers and non-treatment seekers on any of the subject characteristics,  $\chi^2$  statistics were used for the

categorical data (sex) and univariate analyses of variance (ANOVA) were used for the continuous data (age, adjusted BMI, the ChEDE subscales and CDI depression score). Furthermore, Pearson correlations were computed among the study variables.

Next, structural equation modelling (SEM) was used to investigate the relations between the study variables. To evaluate model goodness of fit of the measurement model, two fit indices were inspected: the comparative fit index (CFI) and the root mean squared error of approximation (RMSEA). In general, a CFI >0.90 indicates acceptable fit and >0.95 indicates good fit. An RMSEA value up to 0.08 indicates an acceptable fit and a value of 0.05 or lower indicates a good fit [3, 7, 36, 44]. We will first investigate the measurement model with confirmatory factor analysis. SEM with latent variables was performed, using LISREL 8.72 [37] and solutions were generated on the basis of maximum likelihood estimation.

## Results

### Sample characteristics

The participants ( $N = 350$ ) had a mean BMI of 31.27 ( $SD = 5.60$ ) with a range of 20.04–50.70 and a mean adjusted BMI of 169.78% ( $SD = 27.21$ ) with a range of 120–256% (CDC BMI- $z$  scores range from 0.98 to 2.78). On the basis of the IOTF BMI cut-off points, 22% of the participants was classified as overweight and 78% as obese. Table 1 presents the characteristics of the whole sample and of the treatment seekers and non-treatment seekers separately. No significant sex differences were found between the treatment seekers and non-treatment seekers,

$\chi^2(1) = 0.14$ ,  $P = 0.79$ . Both samples did however differ in age,  $F(1,347) = 3.83$ ,  $P \leq 0.05$  and Adjusted BMI,  $F(1,343) = 90.16$ ,  $P < 0.001$ . Treatment seekers were younger and were characterized by a significantly higher Adjusted BMI compared to the non-treatment seekers.

Overall, the mean number of LC episodes reported over the last 3 months by the entire sample ( $N = 350$ ) was 2.61 ( $SD = 9.78$ ) with a range of 0–90 episodes. In the treatment seeking sample ( $N = 277$ ), the mean number of LC episodes was 2.87 ( $SD = 10.08$ ) with a range of 0–90 episodes. Also, 18.1% of the treatment seekers who reported LC was characterized by a clinical ( $\geq 19$ ) CDI depression score ( $M = 13.58$ ,  $SD = 5.26$ ). In the non-treatment seeking sample ( $N = 73$ ), the mean number of LC episodes was 1.62 ( $SD = 8.55$ ) with a range of 0–72 episodes. In the non-treatment seekers, 13.3% of those reporting LC had a clinical ( $\geq 19$ ) CDI depression score ( $M = 13.01$ ,  $SD = 7.73$ ). No significant difference was found between the percentage of treatment seekers (27.1%) and the percentage of non-treatment seekers (20.5%) who reported LC,  $\chi^2(1) = 1.40$ ,  $P = 0.24$ . Among all the participants (of the entire sample) who reported LC (25.7%) a mean number of 8.94 episodes ( $SD = 13.73$ , range 1–90) was reported over the last 3 months.

### Correlations between the study variables

Table 2 represents the Pearson's correlations between the main study variables. First of all, this table indicates that both restraint and depression were significantly and positively related to LC severity (number of LC episodes). The correlation coefficients also indicate that the association between restraint and LC severity ( $r = 0.13$ ) turned out to be from a similar order than the association between

**Table 1** Characteristics of the whole sample and of the treatment seekers and non-treatment seekers separately

	Whole sample ( $N = 350$ )	Treatment seekers ( $N = 277$ )	Non-treatment seekers ( $N = 73$ )	$F/\chi^2$ statistic
Sex (M/F)	141/209	113/164	28/45	0.79
Age	13.30 (2.17)	13.18 (2.05)	13.74 (2.54)	3.83*
Adj BMI	169.78 (27.21)	176.20 (25.90)	145.85 (16.66)	90.16***
LC/NoLC	90/260	75/202	15/58	1.40
ChEDE eating concern	0.59 (0.73)	0.62 (0.73)	0.46 (0.71)	2.93
ChEDE weight concern	1.92 (1.07)	1.94 (1.07)	1.86 (1.07)	0.32
ChEDE shape concern	1.89 (1.24)	1.92 (1.22)	1.76 (1.32)	1.01
ChEDE restraint	1.08 (1.03)	1.04 (1.02)	1.26 (1.07)	2.74
CDI depression	11.94 (6.37)	12.26 (6.34)	10.86 (6.41)	2.76

Sex and LC is expressed as a number ( $n$ ) of the sample; age and adjusted BMI are expressed as a mean ( $SD$ ) of the sample

M male, F female, BMI body mass index, LC loss of control over eating, NoLC no loss of control over eating, ChEDE children's eating disorder examination, CDI children's depression inventory

\*  $P \leq 0.05$ , \*\*\*  $P < 0.001$

**Table 2** Pearson correlations between the main study variables

	(1)	(2)	(3)	(4)	(5)	(6)
(1) LC severity		0.43***	0.21***	0.34***	0.13*	0.13*
(2) ChEDE eating concern			0.42***	0.55***	0.33***	0.32***
(3) ChEDE weight concern				0.75***	0.40***	0.26***
(4) ChEDE shape concern					0.35***	0.30***
(5) ChEDE restraint						0.04
(6) CDI depression						

LC loss of control over eating, ChEDE children's eating disorder examination, CDI children's depression inventory

\*  $P < 0.05$ , \*\*\*  $P < 0.001$

depression and LC severity ( $r = 0.13$ ). Second, results show that eating, weight and shape concerns were not only significantly and positively correlated with restraint but also with depression and LC severity. Finally, this table also indicates that no significant association existed between restraint and depression.

#### The measurement model

The latent over-evaluation of eating, weight and shape variable (*over evaluation*) was measured with the items from the three ChEDE subscales eating concern (5 items), weight concern (5 items) and shape concern (8 items). The latent dietary restraint variable (*restraint*) was measured with the items from the ChEDE subscale restraint (5 items). The latent depressive symptoms variable (*depression*) was measured with the items from the CDI divided into three partials. The CDI consists of 27 items and each item was randomly assigned to one of the partials. The latent loss of control variable (*LC*) was measured with the dichotomous Loss variable (0 = no episodes of LC, 1 = at least one episode of LC) and with the LC severity variable (number of LC episodes). Because of the age and adjusted BMI differences between treatment seekers and non-treatment seekers that were found in the present sample, and also because of the differences in psychopathology between both groups that were already detected in past literature [6], participants' group status (0 = non-treatment seeking, 1 = treatment seeking) was accounted for in the subsequent analyses.

Data screening of the subscale scores (the observed variables) indicated data non-normality, both at the univariate and multivariate level. Therefore, in the subsequent model we used the asymptotic covariance matrix between all indicators as input and inspected the Satorra–Bentler scaled chi-square (SBS- $\chi^2$ ) [43]. A confirmatory factor analysis testing the relationships between the abovementioned observed and latent variables revealed an acceptable model fit, SBS- $\chi^2$  (68) = 170.26,  $P < 0.001$ ; RMSEA = 0.066, CFI = 0.95. Table 3 provides an overview of the parameter

**Table 3** Parameter estimates (unstandardized solution) and standard errors of each partial loading on the latent constructs

Latent construct	Partials	Parameter estimate		<i>t</i> value
		US	SE	
over evaluation	Eating concern	0.33	0.04	8.41
	Weight concern	0.40	0.05	8.49
	Shape concern	0.29	0.07	4.15
restraint	R1	1.58	0.33	4.83
	R2	0.21	0.05	3.99
	R3	1.96	0.29	6.63
	R4	1.82	0.22	8.15
	R5	4.07	0.38	10.83
Depression	CDI1	2.20	0.29	7.61
	CDI2	2.64	0.31	8.61
	CDI3	2.23	0.23	9.55
LC	LC severity	47.75	24.30	1.96
	Loss	0.12	0.02	6.25

LC loss of control, R restraint subscale of the ChEDE, CDI children's depression inventory, LC severity number of LC episodes, loss presence versus absence of LC, US unstandardized solution, SE standard error; *t* value  $\geq 1.96$  is significant

estimates (unstandardized solution) and standard errors of each partial loading on the latent constructs.

#### The structural model

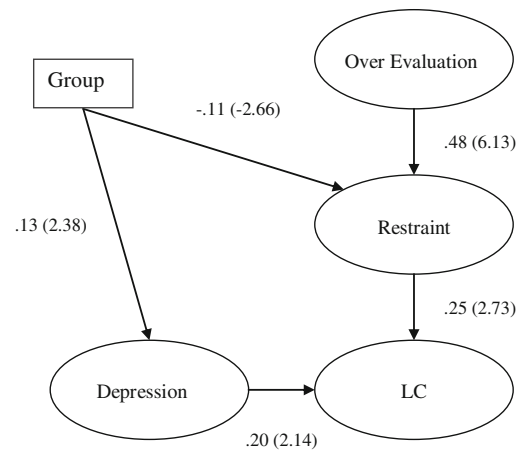
In the structural model the relationship between the independent and dependent variables was tested. More specifically, it was hypothesized that after taking in account treatment status (group), the over-evaluation of eating, weight and shape (over evaluation) would be significantly associated with dietary restraint (restraint) which in turn would exert a direct effect on LC. Also, it was hypothesized that depressive symptoms (depression) would exert a direct effect on LC. Although the fit of this model was acceptable, it might be considered rather poor, SBS- $\chi^2$  (71) = 232.79,  $P < 0.001$ , RMSEA = 0.08, CFI = 0.91.

Because Table 2 showed that in our sample, depressive symptoms were not only significantly correlated with LC but also with the over-evaluation of eating, weight and shape, we added the association between the latent over evaluation and the latent depression. The inclusion of this correlation is consistent with recent findings that the over-evaluation of eating, weight and shape is strongly associated with poor psychological functioning, such as elevated symptoms of depression (Grilo et al. 2008; Hrabosky et al. 2007). Results showed that this model had a more acceptable fit,  $SBS-\chi^2(70) = 204.02$ ,  $P < 0.001$ ,  $RMSEA = 0.07$ ,  $CFI = 0.93$ . Also, a comparison between the model Akaike's information criterion (AIC) [13] of the initial model ( $AIC = 397.91$ ) and the supplemented model ( $AIC = 358.86$ ), whereby the model with the smallest AIC is considered more acceptable, indicated that the model including the correlation between over evaluation and depression was more acceptable. Also in this latter model, it was found that Group was significantly related to both restraint (standardized  $\beta = -0.11$ ,  $t = -2.66$ ) and depression (standardized  $\beta = 0.13$ ,  $t = 2.38$ ), indicating that treatment seekers were characterized by lower degrees of dietary restraint and higher levels of depressive symptoms, whereas non-treatment seekers were characterized by higher degrees of dietary restraint and less depressive symptoms.

With regard to the proposed hypotheses, results showed that over evaluation was positively associated with restraint (standardized  $\beta = 0.48$ ,  $t = 6.13$ ). Restraint was in turn significantly and positively associated with LC (standardized  $\beta = 0.25$ ;  $t = 2.73$ ). Also, a significant and positive relation was found between depression and LC (standardized  $\beta = 0.20$ ,  $t = 2.14$ ). Finally, a significant indirect effect was found between over evaluation and LC (standardized  $\beta = 0.12$ ,  $t = 2.51$ ). The significant relationships are illustrated in Fig. 1.

## Discussion

The present study evaluated possible mechanisms for understanding loss of control over eating (LC) among a large sample of overweight children and adolescents. First of all, results indicated that 26% of the youngsters in the present sample reported having experienced LC over the last 3 months whereby no significant differences in the occurrence of LC were found between treatment seekers (27%) and non-treatment seekers (21%). These percentages were comparable to the rates found in other samples of overweight children and adolescents that also used a clinical interview to assess the presence of LC [16, 52] and show that LC is an ED symptom which is prevalent among a substantial part of both treatment seeking and



**Fig. 1** The dietary restraint and negative affect pathway to loss of control over eating (LC) tested in overweight youngsters after controlling for treatment status. *Over evaluation* over evaluation of eating, weight and shape, *restraint* dietary restraint, *depression* depressive symptoms, *group* treatment seeking versus non-treatment seeking; each pathway listed was significant at  $P < 0.05$  level; standardized path coefficients are listed;  $t$  values are between parentheses

non-treatment seeking overweight children and adolescents.

Based on the central assumptions of the CBT-E [21], a model was tested combining the dietary restraint pathway and depression pathway to LC. Results initially showed that the data did not fit the theoretical model well. Therefore, based on recent empirical findings [35] and based on the results of the present study's correlation matrix, it was decided to supplement the model with an association between the over-evaluation of eating, weight and shape and symptoms of depression. This resulted in a more acceptable model fit, confirming the main predictions of the model.

More specifically, after taking in account differences between treatment seekers and non-treatment seekers, and after controlling for the association between the core psychopathology and symptoms of depression, the present study found evidence for the dietary restraint pathway to LC. First of all, in line with previous cross-sectional [53] and prospective [2] studies in children results of the present study indicated that higher levels of concerns about eating, weight and shape were associated with elevated levels of dietary restraint. Next, results of the present study showed that dietary restraint was in turn significantly associated with the experience of LC. This latter finding is in line with cross-sectional studies in a sample of both normal weight and non-treatment seeking overweight youngsters [53] and with prospective studies in child [2] and adolescent community samples [48, 49].

Remarkably, results showed that overweight youngsters from our non-treatment seeking sample reported higher

levels of restraint compared to those from the treatment seeking sample. This finding is in contrast with the general observation among overweight adults [25] and youngsters [5, 6], that those who seek treatment were characterized by higher levels of psychopathology and consequently may be considered as a more pathological group. In the present study, however, we need to differentiate higher scores on dietary restraint from the general measures of psychopathology that were used in the Braet et al. [5] study. Also, when comparing the mean ChEDE restraint score of our non-treatment seeking sample to those of the Tanofsky-Kraff et al. [53] study, we may conclude that the non-treatment seekers in the present study were characterized by exceedingly high levels of dietary restraint. In other words, although these youngsters declared that they were not seeking or following any kind of treatment for their overweight at the time of the study, they did have intentions (or even made attempts) to restrict their food intake. All together, we may conclude that even when taking into account differences between treatment seekers and non-treatment seekers, the conclusion holds on that as assumed, the experience of LC appears to be directly associated with dietary restraint among overweight youth.

Furthermore, results showed a significant indirect relation between the ‘core psychopathology of EDs’ (the over-evaluation of eating, weight and shape) and LC. In line with recent studies among adult samples of patients with binge eating disorder [34, 35], this finding indicates that being over-concerned is not simply a characteristic of overweight individuals, but is also indicative of more severe ED pathology thereby emphasizing the importance of assessing the occurrence of this ‘core pathology’ among overweight youth.

Next to the dietary restraint pathway, the present model investigated the relevance of the depression pathway to LC [19]. After taking into account differences between treatment seekers and non-treatment seekers, results of the present study showed that the experience of LC was also significantly related to elevated levels of depressive symptoms. This finding is in line with some research [16, 32] but in contrast with other studies, where no such relation could be detected between LC and depressive symptoms [54]. Moreover, results showed that in contrast with the assumptions of the CBT-E [19], but in line with recent research in adults [34, 35], depressive symptoms were also significantly correlated with the over-evaluation of eating, weight and shape. This finding indicates that among overweight youth, the system of over-evaluating eating, weight and shape does not only play a central role in the dietary restraint pathway but may also be an essential component in the depression pathway to LC.

The findings of the present study have some clinical implications. More specifically, when overweight

youngsters present for treatment, it seems important to screen them for the presence of ED pathology, such as the level of concerns about eating, weight and shape and the presence of LC. Also, it will be important to screen these youngsters for the presence of depressive symptoms. If present, overweight treatment may be supplemented by providing these youngsters adequate techniques for coping with negative emotions, for increasing their self-worth and for acquiring adequate self-control strategies. Both in treatment seeking and non-treatment seeking overweight youngsters, early detection and treatment of eating pathology and its correlates might prevent them of developing more severe ED pathology and adult obesity [45, 49] later on. Furthermore, results showed that non-treatment seekers were characterized by higher levels of dietary restraint and lower degrees of overweight compared to treatment seekers. Because of their lower degree of overweight, these overweight youngsters may not call in assistance as quickly as the more obese treatment seekers, and as a consequence of that they may not learn how to target their overweight (e.g. by acquiring a more healthy lifestyle). Moreover, the fact these non-treatment seekers are also characterized by elevated levels of dietary restraint, which was found to be associated with LC, even adds to their vulnerability for adverse outcomes later on.

Strengths of the current study include the use of the interview methodology. Especially for assessing key ED behaviours such as LC in younger samples, the use of the ChEDE [8, 15] is highly recommended [14]. Also, the utilization of this interview made it possible to compare our results with the results obtained by other recent studies who also used the (Ch)EDE [52, 54]. Another strength of the present study was that to our knowledge, this was the first study investigating the main assumptions of the CBT-E with a central focus on the competitiveness of dietary restraint versus depression among a large sample of both treatment seeking and non-treatment seeking overweight youngsters.

This study has also some limitations. First of all, this study is to be considered explorative and the results of this study will definitely need to be cross-validated in other samples and with the use of other measures. Moreover, it needs to be acknowledged that not all constructs of the CBT-E [21] were operationalized like they were in the original model. For example, the construct of mood intolerance may comprehend a broad range of adverse mood states. In line with this, recent empirical evidence shows that LC may be associated with different affect regulation strategies in community samples [12] as well as in overweight youngsters [33], depending on which adverse mood state has to be regulated. Because of practical reasons, however, we exclusively focused on the role of depressive symptoms in the present study. Future research should



investigate the differential role of other adverse mood states (like anger and anxiety) for the regulation of LC as well. Also, since no measure of anxiety was assessed, no conclusions could be drawn regarding the role of negative affect, which is considered the common component of anxiety and depression [9]. Another limitation was that our model was tested with the use of a cross-sectional design so consequently, we were only able to make conclusions about associations between variables. This design does not make it possible to draw causal relationships between the study variables. Therefore, replication of our results with the use of a prospective study design will be needed. A next limitation has to do with the sample size. Although our analyses were conducted on 350 overweight youngsters, which can be considered a large sample, ‘only’ 26% of them reported LC. In order to replicate the present findings and to further examine possible pathways to LC, it will be interesting for future research to recruit a large sample that entirely and exclusively consists of youngsters who report LC.

A final limitation regards the composition of the overweight sample, which was rather heterogeneous (different treatment statuses and different severities of overweight). Since results showed a significant effect of treatment status, future research should further investigate underlying mechanisms leading to LC among more ‘pure’ samples of exclusively treatment seekers or exclusively non-treatment seeking overweight youngsters. Also, it will be worthy to examine whether those differences may be attributed to the treatment status itself, or rather to the degree of overweight.

Next, future research may also investigate the importance of sub-typing overweight youth along the dimensions of depression and dietary restraint. Although the present study demonstrates that LC may be explained by both failing attempts to restrict food intake as well as by an inability to cope with depressive symptoms, little is known about the concurrence and prognosis of both pathways. Research in adults with binge eating has already shown that those characterized by high levels of both dietary restraint and negative affect show the poorest prognoses [46, 47]. Accordingly, preliminary findings in a paediatric sample suggest that the presence of negative affect is indicative of a more severe variant of LC [31] but up until now little is known about how these different subtypes further evolve. Also, as suggested by Macht [40], emotion-induced changes of eating may vary across individuals (e.g. high vs. low restrained) and across emotions (e.g. high vs. low intensity). In order to improve our understanding of the specific effects emotions have on eating, this twofold variability needs to be taken in account. Finally, future research should also investigate more thoroughly the role of the ‘core psychopathology’ in (overweight) youngsters. Although many studies have already investigated the role of body

dissatisfaction (see Stice and Shaw [48] for an overview), far less research in young populations focused on the over-evaluating system of eating, weight and shape [2].

To conclude, results of the current study show that the CBT-E may serve as an adequate theoretical background for evaluating the development and maintenance of loss of control over eating among overweight youth.

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