Published in final edited form as:

Eat Behav. 2019 April ; 33: 18–22. doi:10.1016/j.eatbeh.2019.02.001.

Perceived Family Functioning among Adolescents with and without Loss of Control Eating

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1. Introduction

Loss of control eating (LOC), defined as a sense of loss of control over eating regardless of the amount of food consumed, is a prevalent disordered eating behavior in adolescence. Youth with LOC are at increased risk for excessive weight gain (Tanofsky-Kraff et al., 2009), psychological distress, and the onset of binge-eating disorder (BED) (Hilbert & Brauhardt, 2014; Tanofsky-Kraff et al., 2011). Interpersonal difficulties and accompanying negative affect, both of which are more prominent among youth with LOC compared with those without (Cassidy, Shank, Matherne, Ranzenhofer, & Tanofsky-Kraff, 2016; Ranzenhofer et al., 2014), have particular salience in youth's LOC eating behaviors. Cross-sectional studies of adolescents indicate that negative affect mediates the association between social problems and LOC (Elliott et al., 2010) and between social stress and intake of palatable foods among youth with LOC in a laboratory setting (Shank et al., 2017). Prospectively, poor perceived social support has been implicated in the onset of binge eating (Stice, 2002), and interpersonal problems temporally precipitate LOC episodes (Ranzenhofer et al., 2014). These data are largely consistent with the interpersonal model of binge eating, which proposes that interpersonal difficulties lead to negative emotional states, which in turn promote binge eating behavior as a method of coping with negative affect (Wilfley, Wilson, & Agras, 2003).

Although family relationships remain important during adolescence, little is known about family functioning among adolescents with LOC. Among predominately child samples, LOC is associated with poorer observed family functioning at family mealtime, with interactions marked by less effective communication patterns and less interest in family members' activities (Czaja, Hartmann, Rief, & Hilbert, 2011), as well as more parental

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Conflict of Interest: The authors declare that they have no conflict of interest.

negative comments about shape, weight, and eating (Hilbert, Tuschen-Caffier, & Czaja, 2010) compared with youth without LOC. Retrospectively, children with LOC also recall greater parental problems (parental under-involvement and arguments) and negative comments from family about eating, shape and weight (Hartmann, Czaja, Rief, & Hilbert, 2012). Similarly, adolescents with BED indicate less familial emotional expression and perceive their parents as less warm and more critical than control participants (Schmidt, Tetzlaff, & Hilbert, 2015), suggesting similar associations between poor perceived family functioning and disordered eating presentation among youth with BED.

In sum, existing data suggest that interpersonal functioning may be an important factor in the development and maintenance of LOC patterns in youth. However, relatively little is known about the quality of family functioning among adolescents with LOC. This is a critical gap in the literature as adolescence is a period in which parent-child dynamics are evolving yet remain influential in children's socioemotional adjustment (Smetana, Campione-Barr, & Metzger, 2006). Therefore, the purpose of this study was to evaluate perceived family functioning among adolescents with and without LOC. Based on prior research among children with LOC and adolescents with BED (Schmidt, Tetzlaff, & Hilbert, 2015; Tetzlaff, Schmidt, Brauhardt, & Hilbert, 2016), we hypothesized that youth with LOC would report worse family functioning than youth without LOC. However, given the relative lack of prior research in this domain, we had no specific hypothesis regarding which aspects of family functioning might differ based on LOC status. We accounted for body mass index as LOC is associated with overweight status in adolescence (Cassidy et al., 2016).

Consistent with an interpersonal model, which would suggest that poor perceived family functioning would relate to negative mood and subsequent LOC eating, we also examined the impact of depressive symptoms on associations between family functioning variables and LOC since research in this area is lacking.

2. Methods

2.1 Participants and Procedure

Participants included a convenience sample of 990 male and female monozygotic and dizygotic twins from the Colorado Center for Antisocial Drug Dependence study (CADD; PIs Crowley & Hewitt), a longitudinal study that includes a subsample of youth from the Colorado Community Twin Study (CTS) and the Longitudinal Twin Study (LTS), conducted at the Institute for Behavioral Genetics at the University of Colorado. Recruitment and inclusion criteria for CADD have been described previously (Rhea, Gross, Haberstick, & Corley, 2013). For the present study, we excluded youth who were missing LOC data ($n = 12$) or endorsed self-induced vomiting ($n = 20$) to eliminate youth potentially exhibiting bulimic-type pathology. Parents and participants provided informed consent and assent, respectively. The University of Colorado's Institutional Review Boards in Boulder and Denver approved this study.

2.2 Measures

Presence (LOC) or absence (noLOC) of LOC was assessed using one binary question ("Is it sometimes hard to stop eating?"). This item is taken from a 7-item eating disorder screening

tool that is part of the standard assessment and has been previously validated as a measure of disordered eating attitudes and behaviors (Munn-Chernoff et al., 2012). Family functioning was assessed using the relationship dimension of an adapted version of the Family Environment Scale (FES) (Moos & Moos, 1994), which includes three subscales: cohesion, expressiveness, and conflict. Higher scores on cohesion and expressiveness reflect more positive family functioning, whereas lower scores on conflict represent more adaptive family functioning. Scale reliability was originally reported to be acceptable (Moos & Moos, 1994). Follow-up data indicate acceptable reliability on the FES cohesion and conflict subscales, although reliability of the FES expressiveness scale is less certain (Boyd, Gullone, Needleman, & Burt, 1997). Cronbach's α in the present sample were acceptable for the cohesion ($\alpha = .81$) and conflict ($\alpha = .71$), but poor for the expressiveness scale ($\alpha = .57$). Covariates included: 1) age and race (coded dichotomously as White vs. other), 2) body mass index, calculated from self-reported height and weight and converted to z-scores (BMIz) based on Center for Disease Control growth charts (Centers for Disease Control and Prevention (CDC), n.d.; Kuczmarski et al., 2002) and 3) depressive symptoms, measured with the total score of the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1991), which is a reliable and valid 20-item scale (range = 0–60) assessing the core symptoms of depression in adolescents (Radloff, 1991). Higher scores on the CES-D indicate more psychopathology. Internal consistency for the CES-D was good in the present sample ($\alpha = .87$).

2.3 Data Analysis

Descriptive statistics were generated on all study variables using SAS version 9.4 (SAS Institute Inc., Cary, NC). General linear models that included generalized estimating equations (GEE) using PROC GENMOD (in SAS) examined associations between family functioning (independent variables) and LOC status (dependent variable) while accounting for the non-independence of twin data. Odds ratios (ORs) with 95% confidence intervals were generated from GEE. Model 1 included demographic factors (i.e., age and race) and BMIz. Model 2 additionally included depressive symptoms. The false discovery rate (FDR) method (Benjamini & Hochberg, 1995) using PROC MULTTEST was used to adjust for multiple comparisons. We then formally tested whether depression mediated the association between FES conflict and LOC in girls using Mplus v8 (Muthen & Muthen, 2017), estimating 1000 bootstrap draws to obtain bootstrapped standard errors and confidence intervals. Results were considered significant at $p < .05$.

3. Results

Our study sample included 990 youth (age = $17.47 \pm .71$ years; 53% female). The majority of participants were White (89%) and non-Hispanic (90%), with a minority of Black/African-American (1%), other or multiple races (8.5%), or unknown/not reported race (1.5%) youth. Youth were predominately (84%) non-overweight (BMI < 85th percentile). As girls were more likely than boys to endorse LOC ($p < .001$), analyses were conducted separately by sex. Girls with LOC endorsed more depressive symptoms on average ($p < .001$), but did not differ significantly in mean BMIz ($p = .47$), mean age ($p = .06$), or race ($p = .19$) compared with girls without LOC. Boys with LOC had a higher mean BMIz ($p = .01$),

but did not differ significantly in age ($p = .61$) or depressive symptoms ($p = .38$) from boys without LOC (Table 1).¹ Consistent with prior research on youth with LOC (Tanofsky-Kraff et al., 2007), both girls and boys with LOC reported greater emotional eating (girls: $p < .001$, boys: $p = 0.02$) and secretive eating (girls: $p = .005$, boys: $p = 0.03$) than youth without LOC. Importantly, there were no significant differences on family functioning subscales among twin pairs in which one twin endorsed LOC and their co-twin did not ($n = 100$ discordant twin pairs, $ps > .05$), suggesting that family functioning subscales do not significantly differ within the family based on twin LOC status. These data indicate that twins within the same family perceive similar environments regarding family functioning, supporting the notion that the FES was measured reliably in the sample.

Table 2 includes descriptive statistics and results from the general linear models. In girls, odds of reporting higher or lower scores on FES cohesion (Model 1: $p = .55$, Model 2: $p = .98$) or expressiveness (Model 1: $p = .55$, Model 2: $p = .87$) subscales did not differ based on LOC status. Girls with LOC had higher odds of reporting greater family conflict compared with girls without LOC ($p = .02$). When accounting for depressive symptoms, the difference was no longer significant ($p = .26$). Results from the mediation model (see Figure 1) indicated that conflict's influence on LOC was mediated by depression ($beta = .08$, $p = .04$). However, conflict also had a direct influence on LOC ($beta = .21$, $p = .03$). Boys with and without LOC did not differ on any family functioning subscales ($ps > .05$).

4. Discussion

This study investigated perceived family functioning among youth with and without LOC. Findings suggest that youth with LOC have similar perceptions of familial cohesion compared with their peers without LOC, corroborating research indicating that adolescents with and without BED do not differ significantly in their perception of family connectedness (Tetzlaff et al., 2016). Youth with and without LOC also did not differ with respect to perceived emotional expressiveness, which is inconsistent with prior research examining adolescents with BED (Schmidt et al., 2015; Tetzlaff et al., 2016).

Girls with LOC perceived more family conflict compared with girls without LOC. Notably, the association between family conflict and LOC was no longer significant when accounting for depressive symptoms. With further analysis, results revealed that depressive symptoms mediated the association between family conflict and LOC in girls. This finding is in line with the interpersonal model of binge eating, which proposes that interpersonal difficulties lead to negative affect (e.g., depressive symptoms), which in turn prompts binge eating behavior. Our findings converge with prior cross-sectional data supporting an interpersonal model of LOC among youth broadly examining social problems (Elliott et al., 2010) and further extend support of an interpersonal model of LOC to the family environment in adolescent girls. Associations between family functioning, depressive symptoms, and LOC were not significant in boys. These results are consistent with prior research indicating that family functioning may have a stronger impact on disordered eating presentation in girls

¹Similar comparisons examining race among boys with and without LOC did not have adequate power to determine significance as there were very low numbers of minority youth ($n = 1$) among LOC boys.

(Berge et al., 2014), and that depressive symptoms are more prominent among adolescent girls compared with boys (Wade, Cairney, & Pevalin, 2002).

Given our findings that depressive symptoms accounted for the association between family conflict and LOC in girls, results emphasize the importance of assessing for LOC eating behaviors among adolescents with depressive symptoms, and in targeting depressive symptoms in LOC intervention efforts. Notably, as family functioning was assessed by self-report, results do not necessarily imply that family conflict is elevated among girls with LOC, but rather that girls with LOC *perceive* more family conflict. Although research indicates that adolescence is a developmental period marked by increased parent-child conflict (Smetana et al., 2006), studies indicate that adaptive family functioning may be protective against binge eating behavior (Berge et al., 2014). Furthermore, it is well-established that the family unit can be effectively leveraged in the treatment of adolescent eating disorders (Couturier, Kimber, & Szatmari, 2013) and depression (Diamond, Russon, & Levy, 2016). While results from the present study may suggest that enhancing familial communication and conflict resolution could be pertinent to LOC intervention efforts, particularly with girls, additional research investigating the temporal nature of these relations in more diverse and clinical samples is needed to clarify treatment indications.

We included BMI_z and depressive symptoms as covariates given known associations between weight and depressive symptoms and LOC status (Cassidy et al., 2016). In line with prior research, boys with LOC had a higher mean BMI_z compared with boys without LOC. Unexpectedly, there was no association between BMI_z and LOC among girls, which may indicate underreporting of overweight status, which is particularly common among overweight and female adolescents (Sherry, Jefferds, & Grummer-Strawn, 2007). Examining depressive symptoms, girls with LOC had elevated depressive symptoms compared with girls without LOC; this finding was not mirrored among boys. As the sample investigated included predominately non-overweight youth with depressive symptoms in the non-clinical range, lack of between-group differences is likely explained by low sample variation and the low number of boys with LOC. Alternatively, results may reflect the demographic from which the sample was taken, in which the prevalence of overweight is reduced relative to the average United States population, particularly among adolescent girls (Colorado Department of Public Health & Environment, 2015). Specific to depressive symptoms, most prior studies examining LOC among adolescents have not examined boys and girls separately, which is notable given the sex differences in depressive symptoms that emerge during adolescence (Wade et al., 2002).

Findings are limited by the study's cross-sectional nature, use of a relatively healthy, homogenous sample, and a smaller number of boys than girls with LOC. Moreover, our measure of LOC was based on one item that has not specifically been validated against another measure of LOC in adolescents, and did not include information regarding the frequency of LOC (which has been done previously (Berge et al., 2014)), possibly obscuring subgroups based on LOC severity. Our findings are further limited by uncertain reliability and poor internal consistency on one of the three subscales (FES expressiveness) used to assess family functioning. Notably, our model results differed slightly, in that the mediation model indicated a direct significant association between conflict and LOC, whereas this

association was non-significant when depression was included in the regression model. However, the regression model only became non-significant when accounting for multiple comparisons (FDR), suggesting that model discrepancies are due to a more stringent control in the regression model compared with the mediation model, rather than true inconsistencies in our results. Study strengths included examination of a large sample of girls and boys. Additionally, comparing models that do versus do not contain comorbid depressive symptoms with LOC facilitated a broader examination of the impact of depressive symptoms on these relations, as well as a test of the interpersonal model of LOC.

In summary, findings from this study suggest associations between perceived family conflict, depressive symptoms, and LOC during adolescence. Consistent with an interpersonal model, depressive symptoms mediated the relation between family conflict and LOC. Future studies using a more thorough measure of LOC are needed to clarify these relations and examine the impact familial factors have on LOC over time.

Acknowledgments

Research support: This work was supported by HD010333 from the National Institute of Child Health and Human Development, by AG046938 from the National Institute on Aging, and by AA025113 (MMC) from the National Institute on Alcohol Abuse and Alcoholism.

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Figure 1.

Depressive symptoms as a mediator of the association between family conflict and loss of control

Note: Model examining depressive symptoms as a mediator of the association between family conflict and loss of control (LOC) eating. Standardized regression paths and 95% confidence intervals are shown. Note: The indirect path from family conflict to LOC through depressive symptoms was significant ($\beta = .08$ (.02, .14), $p = .04$), suggesting that depressive symptoms mediated the association between family conflict and LOC. * $p < .05$, ** $p < .001$

Table 1.

Demographic information by loss of control eating (LOC) status and sex

	<u>Girls</u>			<u>Boys</u>		
	<u>LOC n = 111</u>	<u>NoLOC n = 413</u>	<u>p-value</u>	<u>LOC n = 47</u>	<u>NoLOC n = 419</u>	<u>p-value</u>
	<u>M (SD)</u>	<u>M (SD)</u>		<u>M (SD)</u>	<u>M (SD)</u>	
Age (y)	17.65 (.72)	17.48 (.69)	.06	17.44 (.78)	17.41 (.72)	.62
BMI z-score	-.00 (1.04)	-.05 (.92)	.47	.67 (1.17)	.06 (1.09)	.01
Depressive symptoms	1.65 (.40)	1.45 (.36)	<.001	1.52 (.40)	1.43 (.34)	.38
	<u>n (%)</u>	<u>n (%)</u>		<u>n (%)</u>	<u>n (%)</u>	
Eating in Secret	24 (21.62)	29 (7.02)	.01	18 (4.30)	9 (19.15)	.03
Emotional Eating	44 (39.64)	40 (9.69)	<.001	8 (1.91)		.02
Race (% White)*	91 (81.98)	364 (88.14)	.19	46 (97.87)	378 (90.21)	--

Note: LOC = youth with loss of control eating, noLOC = youth without loss of control eating, BMI = body mass index. SDs may not be as broad as they would for a completely independent population.

* Inadequate *n* across categories to support analyzing the model among boys.

Table 2.

Descriptive statistics for family functioning and peer variables by loss of control eating (LOC) status and odds ratios (ORs) from logistic regression models evaluating the effect of family functioning on LOC by sex

Family Variables	Girls						Boys					
	LOC			noLOC			LOC			noLOC		
	M (SD)			M (SD)			M (SD)			M (SD)		
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
		OR (95% CI)	OR (95% CI)		OR (95% CI)	OR (95% CI)		OR (95% CI)	OR (95% CI)		OR (95% CI)	OR (95% CI)
Family Cohesion	3.65 (.93)			3.79 (.81)	.82 (.62, 1.09)	1.00 (.74, 1.36)	3.62 (.89)			3.64 (.73)	.90 (.54, 1.49)	1.01 (.59, 1.73)
Family Expressiveness	3.11 (.76)			3.25 (.70)	.78 (.56, 1.09)	.94 (.66, 1.33)	3.11 (.65)			3.12 (.62)	.83 (.48, 1.42)	.89 (.52, 1.53)
Family Conflict	2.99 (.77)			2.67 (.77)	1.64 (1.22, 2.20)	1.40 (1.01, 1.94)	2.84 (.77)			2.76 (.69)	1.22 (.73, 2.06)	1.15 (.68, 1.94)

Note: LOC = youth with loss of control eating, noLOC = youth without loss of control eating, CI = confidence interval.

^aModel 1 is adjusted for demographics (age, race) and BMI z-score in girls and for age and BMI z-score in boys

^bModel 2 is further adjusted for total depressive symptoms.

Bolding on family variables represents significance after correction for multiple testing using false discovery rate.