

Determinants of Binge Eating Symptoms in Children with Overweight/Obesity

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Abstract

Background: Examining binge eating symptoms before the diagnosis of binge eating disorder in children with obesity could provide important information on prevention of future eating disorders.

Methods: We examined the prevalence and multilevel determinants of three binge eating symptoms: (1) sneaking, hiding, or hoarding food; (2) eating in the absence of hunger, and (3) inhibition or embarrassment when eating in front of others among 817 children aged 5–12 years old with overweight/obesity receiving primary care in eastern Massachusetts. We examined the associations of child and parent/household characteristics with the prevalence ratios (PRs) of these three binge eating symptoms.

Results: Approximately one-third of parents reported that their children would sneak, hide, or hoard food; 40% ate large amounts in the absence of hunger; and 8% were inhibited/embarrassed when eating in front of others. In multivariate analyses, greater screen time was associated with a higher prevalence of sneaking, hiding, or hoarding (PR 1.06, 95% CI: 1.01–1.11). We found that children with severe obesity (PR 1.50, 95% CI: 1.24–1.81 vs. nonsevere obesity) had higher prevalence of eating in the absence of hunger. Increased hours of screen time were associated with *higher prevalence* of eating in the absence of hunger, (PR: 1.07, 95% CI: 1.03–1.11), whereas longer sleep duration (PR: 0.90, 95% CI: 0.82–0.99) was associated with *lower prevalence* of eating in the absence of hunger.

Conclusions: Eating in the absence of hunger was the most common symptom in our sample and was associated with screen time and sleep. ClinicalTrials.gov NCT01537510.

Keywords: binge eating; childhood obesity; randomized controlled trial

Introduction

The prevalence of childhood obesity remains high despite public health and clinical efforts to prevent and treat obesity.¹ There is also an increasing prevalence of eating disorders, which share common risk factors with obesity such as body dissatisfaction, unhealthy weight control behaviors/dieting, and weight teasing.² Owing to these shared risk factors, there are recommendations that interventions to prevent and manage obesity should address both.² Furthermore, children who eat in the absence of hunger, who have guilty feelings about the behavior, and try

to hide their overeating may develop a binge eating disorder (BED), a condition commonly associated with obesity in adults.^{3,4} Identifying the prevalence and examining the determinants of binge eating symptoms in children with obesity may have important influences on reductions in eating disorders and obesity incidence and prevalence.⁵

The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria for diagnosis of BED requires episodes of binge eating that are defined by at least three of the following symptoms: (1) eating more rapidly than normal, (2) eating until feeling uncomfortably full, (3) eating large amounts of food when not feeling physically

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hungry, (4) eating alone because of embarrassment by the amount of food consumed, and (5) feeling disgusted with oneself, depressed, or guilty after overeating.⁶ These symptoms alone in childhood may precede the development of BED. Among individuals who do not meet diagnostic criteria for an eating disorder, the presence of binge eating and loss of control (LOC) eating still yields risk for excess body weight, elevated eating disorder psychopathology, psychosocial distress, and clinical impairment.⁷ Thus, detection of these symptoms before the development and diagnosis of eating disorders may provide an avenue for prevention.

The prevalence of binge eating among adults with obesity is nearly twice as high as the general population⁸ and evidence suggests that childhood obesity is associated with a history of eating disorders, in particular BED, at a later age.⁹ For example, a recent meta-analysis of 36 articles indicated that binge eating was prevalent among more than one quarter of children and adolescents (age range 5–21 years) with overweight and obesity.¹⁰ Although adults with obesity show a high prevalence of binge episodes, in the case of children, LOC episodes are prevalent.¹¹ In addition, problematic binge eating symptoms in childhood seem to be related to the development of obesity in adolescence.^{9,12}

Recent studies suggest that shame feelings, particularly those related to body image, play an important role in the development of binge eating. These shame feelings may have their roots in early life experiences such as being criticized by parents or bullied by peers.¹³ In a study examining the origins of shame experience from childhood through adolescence, physical appearance-related shame experiences were the most frequently recalled.¹³ Body dissatisfaction, a known risk factor for disordered eating, longitudinally predicted excessive weight gain in a population-based sample of overweight adolescent girls.¹⁴ Binge eating symptoms may emerge as a way to temporarily avoid or decrease the intensity of these negative feelings. Perhaps modifiable behaviors such as sleep and physical activity could alleviate these feelings, whereas other behaviors such as screen time may exacerbate them. Physical activity has been shown to reduce binge eating episodes in adults with BED.¹⁵ A review by Sanchez-Carracedo et al. suggested working with the media to decrease the objectification of women and extreme thinness in girls or extremely muscular bodies in men as a way to prevent disordered eating and obesity, suggesting that screen time may be contributing to negative body image and binge eating symptoms.¹⁶

Although studies support the high prevalence of binge eating among individuals with overweight and obesity and demonstrate the close relationship between disordered eating behaviors and obesity, few studies have examined binge eating symptoms and correlates including modifiable behaviors (sleep, physical activity, and screen time) among a diverse sample of children with overweight or obesity, which could elucidate avenues for prevention of obesity and disordered eating.¹⁷

The objective of this study was to examine the prevalence and multilevel determinants of three binge eating symptoms: (1) sneaking, hiding, or hoarding food; (2) eating in the absence of hunger; and (3) inhibition or embarrassment when eating in front of others in children 5–12 years of age with overweight or obesity. We chose to focus on these three symptoms because of the participants' developmental stage, ease of identifying these symptoms through parental report, and a high prevalence of these symptoms in a previous study conducted by our team.¹⁸ We hypothesized that modifiable behaviors such as sleep, screen time, and physical activity would be associated with these symptoms.

Methods

Study Design and Participants

Study subjects were 817 children aged 5–12 years with BMI >90th percentile who completed a baseline survey for the Study of Technology to Accelerate Research (STAR), a cluster-randomized obesity intervention that took place from October 2011 to July 2013.^{19,20} Electronic health record (EHR) data were available for 740 children. The study took place in 14 pediatric practices in eastern Massachusetts. Children were eligible for the baseline survey if they were 5–12 years old with a BMI >90th percentile and received well child care visits at one of the 14 practices. Recruitment, eligibility, and study procedures of the STAR trial have been previously published.^{19,20} The Harvard Pilgrim Institutional Review Board approved the study protocol and informed consent from participants was obtained.

Exposures

We examined individual, parent, and household characteristics as well as child behavior as exposures. In particular, we examined child age and gender obtained from the EHR, and race/ethnicity from parental report on the baseline survey. We used height and weight from the EHR to calculate age and gender-adjusted BMI percentile and defined severe obesity as ≥ 120 th percent of the 95th percentile of the CDC growth curves.²¹ We examined parental BMI, education level, income, and whether the parent was born in the United States from the baseline survey. We examined child behavior including average screen time hours per day (including TV, smartphones, and computers), sleep duration hours per day, and physical activity hours per week (including walking, light or moderate recreational activities such as biking, and vigorous activities such as running) all of which were collected through parental report from 14 items on the baseline survey.^{22–29}

Outcomes: Binge Eating Symptoms

The outcome measures for this analysis included the endorsement of any of the three binge eating symptoms. The first two questions were chosen from parental reports of children's eating behaviors, and the third was modified from the self-reported question from the Questionnaire on Eating and Weight Patterns-5.³⁰ These three questions

have been asked in previous childhood obesity randomized controlled trials and the endorsement of these binge eating symptoms was found to be prevalent in a similar population of children.¹⁸

1. Does (—) ever sneak, hide, or hoard food?³¹
2. Does (—) ever eat large amounts of food, even when he or she is not hungry?³²
3. Does (—) ever seem to be inhibited or embarrassed when eating in front of others compared with eating alone?^{32,30}

Statistical Analysis

The frequencies of sneaking hiding, or hoarding food, eating in the absence of hunger, or inhibition or embarrassment when eating in front of others were examined, followed by bivariate associations of these behaviors with possible correlates including child age, gender, race/ethnicity, severe obesity, parental BMI, education, age, income (>\$50,000 vs. ≤\$50,000), and US born status. In addition, child behaviors including sleep, screen time, and physical activity were examined individually in the models. For those variables that had a bivariate or *a priori* association with binge eating symptoms, multivariable log binomial regression was performed to estimate adjusted prevalence ratios (PRs) for the association of the child and parent/household characteristics with each binge eating symptom.³³ Models were adjusted for child gender, age, race/ethnicity, severe obesity, parental BMI, education, income, and US born as determined by *a priori* hypotheses, previous literature, and bivariate analyses.^{34–38} Analyses used a complete case analysis, where observations were dropped if there was missing data for the outcome, main exposure, or covariates. Analyses were conducted using SAS 9.4.

Results

Table 1 gives characteristics of the study participants. At baseline, the mean (SD) age was 9.7 years (1.9). Approximately 53% were non-Hispanic white, 20% were black, and 15% were Hispanic; 22% had severe obesity. The mean (SD) parent age was 41 years (6.7). The mean (SD) parental BMI was 29.6 (6.6) kg/m² and 31% of children lived in a family with an income ≤\$50,000 per year.

In bivariate analyses (Table 2), children who sneak, hide, or hoard food were more likely to have a US-born parent (81.5%) than children without this symptom (72.7%, $p=0.01$) (Table 2). Children who had this symptom were also more likely to have higher average screen time per day vs. those without (3.7 hours vs. 3.4 hours, $p=0.02$). Those with the symptom of eating in the absence of hunger reported getting less sleep (9.2 hours vs. 9.3 hours, $p=0.03$), more screen time (3.8 hours vs. 3.3 hours, $p<0.01$), and less physical activity (1.4 hours vs. 1.6 hours $p=0.01$) than those without this symptom.

Table 1. Sample Characteristics of 817 Pediatric Patients Aged 5–12 Years with a BMI ≥90th Percentile in Massachusetts

Individual characteristics	n (%)
Child gender	
Female	375 (45.9)
Male	442 (54.1)
Child race	
Asian/other	104 (12.8)
Black	163 (20.0)
Hispanic	120 (14.7)
White	428 (52.5)
Child age	
Mean (SD)	9.7 (1.9)
Child severe obesity	
No	579 (78.2)
Yes	161 (21.8)
Parental characteristics	n (%)
Parent US born	
No	199 (24.4)
Yes	618 (75.6)
Parent education	
Some college or less	351 (43.0)
College graduate	465 (57.0)
Parent age	
Mean (SD)	41.0 (6.7)
Parent BMI	
Mean (SD)	29.6 (6.6)
Household income	
≤50k	244 (30.9)
>50k	545 (69.1)
Language spoken at home	
English	747 (91.4)
Other	70 (8.6)
Child behavior	Mean (SD)
Sleep (average hours/night)	
Mean (SD)	9.3 (1.0)
Screen time (average hours/day)	
Mean (SD)	3.5 (2.1)
Physical activity (average hours/day)	
Mean (SD)	1.5 (1.4)

Table 2. Bivariate Associations of Individual, Parental Characteristics, and Child Behavior with Binge Eating Symptoms

Characteristics	“Child sneaks, hides, or hoards food”			“Child eats large amounts, even if not hungry”			“Child is inhibited/embarrassed when eating in front of others”		
	No, n (%)	Yes, n (%)	t-Test p-value	No, n (%)	Yes, n (%)	t-Test p-value	No, n (%)	Yes, n (%)	t-Test p-value
Child gender			0.17			0.02			0.41
Female	241 (44.1)	133 (49.3)		208 (42.7)	167 (50.8)		341 (45.5)	34 (50.7)	
Male	305 (55.9)	137 (50.7)		279 (57.3)	162 (49.2)		408 (54.5)	33 (49.3)	
Child race			0.29			0.90			0.12
Asian/other	74 (13.6)	30 (11.2)		61 (12.6)	43 (13.1)		94 (12.6)	10 (14.9)	
Black	117 (21.5)	46 (17.1)		100 (20.6)	63 (19.2)		153 (20.5)	10 (14.9)	
Hispanic	78 (14.3)	42 (15.6)		68 (14.0)	51 (15.5)		104 (13.9)	16 (23.9)	
White	276 (50.6)	151 (56.1)		257 (52.9)	171 (52.1)		396 (53.0)	31 (46.3)	
Child age			0.10			0.01			<0.01
Mean (SD)	9.6 (2.0)	9.9 (1.9)		9.6 (2.0)	9.9 (1.9)		9.6 (1.9)	10.7 (1.6)	
Child severe obesity			0.12			<0.01			0.01
No	397 (79.9)	182 (74.9)		370 (83.5)	209 (70.6)		541 (79.4)	37 (63.8)	
Yes	100 (20.1)	61 (25.1)		73 (16.5)	87 (29.4)		140 (20.6)	21 (36.2)	
Parent US born			0.01			0.01			0.11
No	149 (27.3)	50 (18.5)		135 (27.7)	63 (19.1)		188 (25.1)	11 (16.4)	
Yes	397 (72.7)	220 (81.5)		352 (72.3)	266 (80.9)		561 (74.9)	56 (83.6)	
Parent education			0.80			0.80			<0.01
Some college or less	233 (42.8)	118 (43.7)		208 (42.7)	143 (43.6)		310 (41.4)	41 (62.1)	
College graduate	312 (57.2)	152 (56.3)		279 (57.3)	185 (56.4)		439 (58.6)	25 (37.9)	
Parent age			0.34			0.41			0.59
Mean (SD)	40.8 (6.4)	41.3 (7.3)		41.1 (6.5)	40.7 (7.0)		40.9 (6.6)	41.4 (7.3)	
Parent BMI, continuous			0.40			0.11			0.06
Mean (SD)	29.4 (6.4)	29.8 (7.0)		29.3 (6.3)	30.0 (7.0)		29.4 (6.4)	31.0 (7.7)	
Parent BMI ≥25			0.60			0.01			0.09
<25	149 (27.3)	69 (25.6)		147 (30.2)	71 (21.6)		206 (27.5)	12 (17.9)	
≥25	397 (72.7)	201 (74.4)		340 (69.8)	258 (78.4)		543 (72.5)	55 (82.1)	
Household income			0.77			0.94			0.01
≤50k	165 (31.3)	79 (30.3)		146 (31.1)	98 (30.8)		215 (29.7)	29 (46.0)	
>50k	362 (68.7)	182 (69.7)		324 (68.9)	220 (69.2)		510 (70.3)	34 (54.0)	
Language spoken at home			0.57			0.28			0.43
English	497 (91.0)	249 (92.2)		441 (90.6)	305 (92.7)		683 (91.2)	63 (94.0)	
Other	49 (9.0)	21 (7.8)		46 (9.4)	24 (7.3)		66 (8.8)	4 (6.0)	
Sleep (hours/day)			0.70			0.03			0.19
Mean (SD)	9.3 (1.1)	9.2 (0.9)		9.3 (1.0)	9.2 (1.0)		9.3 (1.0)	9.1 (1.1)	
Screen time (hours/day)			0.02			<0.01			0.06
Mean (SD)	3.4 (2.1)	3.7 (2.1)		3.3 (1.9)	3.8 (2.3)		3.5 (2.0)	4.0 (2.3)	
Physical activity (hours/day)			0.63			0.01			0.09
Mean (SD)	1.5 (1.3)	1.5 (1.6)		1.6 (1.4)	1.4 (1.4)		1.5 (1.3)	1.8 (2.3)	

t-Tests were used for continuous variables and chi-square tests were used for categorical variables.

Table 3. Associations of Individual and Parental Characteristics and Child Behavior with Binge Eating Symptoms

	“Child sneaks, hides, or hoards food” ^a PR (95% CI)	“Child eats large amounts, even if not hungry” ^a PR (95% CI)	“Child is inhibited/embarrassed when eating in front of others” ^a PR (95% CI)
Child characteristics			
Gender			
Female	1.18 (0.96–1.46)	1.17 (0.99–1.40)	0.92 (0.56–1.53)
Male	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Race/ethnicity			
White	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Black	0.83 (0.60–1.14)	0.98 (0.76–1.25)	0.71 (0.32–1.57)
Hispanic	1.11 (0.82–1.51)	1.01 (0.77–1.33)	1.05 (0.52–2.14)
Other race/ethnicity	0.85 (0.59–1.21)	1.08 (0.84–1.39)	1.22 (0.57–2.60)
Age	1.04 (0.98–1.10)	1.03 (0.98–1.08)	1.33 (1.13–1.56)
Severe obesity			
Yes	1.25 (0.96–1.61)	1.50 (1.24–1.81)	1.51 (0.86–2.64)
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Parent characteristics			
Parent US born			
Yes	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
No	0.80 (0.60–1.07)	0.75 (0.58–0.96)	0.59 (0.26–1.31)
Parental BMI (kg/m ²)	1.00 (0.98–1.01)	1.00 (0.99–1.02)	1.00 (0.97–1.04)
Education			
Less than college degree	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
College graduate	1.10 (0.86–1.39)	1.07 (0.88–1.30)	0.60 (0.33–1.10)
Income			
≤\$50,000 per year	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
>\$50,000 per year	1.00 (0.77–1.30)	1.04 (0.83–1.29)	0.59 (0.33–1.06)
Child health behaviors			
Model 1 ^b			
Sleep (hours/night)	0.99 (0.89–1.09)	0.93 (0.85–1.01)	1.03 (0.80–1.33)
Screen time (hours/day)	1.05 (1.01–1.09)	1.05 (1.02–1.09)	1.02 (0.93–1.13)
Physical activity (hours/day)	1.02 (0.95–1.09)	0.90 (0.83–0.98)	1.10 (0.99–1.23)
Model 2 ^c			
Sleep (hours/night)	1.03 (0.92–1.15)	0.90 (0.82–0.99)	1.05 (0.79–1.40)
Screen time (hours/day)	1.06 (1.01–1.11)	1.07 (1.03–1.11)	1.03 (0.91–1.16)
Physical activity (hours/day)	1.01 (0.93–1.09)	0.92 (0.85–1.00)	1.10 (0.99–1.23)

^aModels adjusted for child age, race/ethnicity, severe obesity, parent US born status, parental BMI, income, parental education.

^bModels adjusted for child age, race/ethnicity.

^cModels adjusted for child age, race/ethnicity, severe obesity, parent US born status, parental BMI, income, parental education.

Bold indicates significance.

PR, prevalence ratio.

Children with the symptom of feeling embarrassed/inhibited when eating in front of others vs. those without this symptom were more likely to have severe obesity (36.2 vs. 20.6, $p=0.01$) and more likely to live in a household where the annual income was $\leq \$50,000$ (46.0% vs. 29.7%, $p=0.01$).

In fully adjusted models, each 1 hour increase in screen time was associated with a 1.06 (95% CI: 1.01–1.11) times higher likelihood of having symptoms of sneaking, hoarding, or hiding food (Table 3). No other characteristics were significantly associated with sneaking, hiding, or hoarding food. Children with severe obesity had a higher likelihood of eating in the absence of hunger (PR: 1.50, 95% CI: 1.24–1.81) vs. those without severe obesity. Those children with a parent born outside of the United States were less likely to report this binge eating symptom (PR: 0.75, 95% CI: 0.58–0.96). In fully adjusted models, with each 1-hour increase in sleep, children were less likely to eat in the absence of hunger (PR: 0.90, 95% CI: 0.82–0.99). In addition, each 1-hour increase in screen time was associated with a higher likelihood of children eating in the absence of hunger (PR: 1.07, 95% CI: 1.03–1.11). Each additional year of age was associated with a higher likelihood of feeling inhibited/embarrassed when eating in front of others (PR: 1.33, 95% CI: 1.13–1.56).

Discussion

In this study of 817 children, we found that binge eating symptoms were prevalent and associated with several child and parent characteristics as well as modifiable child behaviors. Of the three binge eating symptoms of interest, we observed that parental report of the child's eating in the absence of hunger had the highest prevalence and was associated with severe obesity in children, parental US born status, and screen time and sleep.

Our results are consistent with previous reports that individuals with shorter sleep duration and insufficient sleep demonstrate overeating, and that shorter sleep duration may be associated with a higher risk of childhood obesity.^{39–42} Our data suggest that shorter sleep duration may be associated with eating behavior in children with obesity. In particular, children getting less sleep were more likely to eat large amounts of food in absence of hunger. A potential mechanism for this observed relationship is supported by previous research that demonstrated that sleep restriction impairs glucose metabolism and alters central nervous control of hunger and appetite, leading to excess food intake.⁴³

In our sample, children exposed to more screen time were more likely to have symptoms of eating in the absence of hunger and sneaking, hiding and hoarding food. We speculate that a potential mechanism could be that children are more likely to eat larger amounts of food in front of the TV because satiety cues are often disregarded.^{44,45} Furthermore, these findings could be explained by previous reports of associations of TV content and its impact on food preference.^{46,47} As noted in the introduction, binge eating symptoms may develop from

shame feelings surrounding body image, which are often propagated by the media.

Physical activity was not found to be associated with any of the binge eating symptoms, which is inconsistent with the adult literature.¹⁵ However, our measure of physical activity was through parental report and not by objective measurement such as by accelerometer. It is also possible that there is a different relationship between physical activity and binge eating in adults vs. children given the different recommendations for physical activity across the lifespan.

Strengths of our study include its large sample size, diversity in sociocultural and economic characteristics, and the measurement of modifiable health behaviors such as screen time and sleep as potential mediators of these binge eating symptoms. In addition, we were able to adjust for multiple covariates. This study also has several limitations. Because the binge eating symptoms were a report of parent's response of "yes" to three questions, it is possible there is a parental reporting bias of children's behavior. In addition, these items came from larger scales that we did not administer in their entirety due to participant burden from the larger randomized controlled trial survey questions. Consequentially, a binge eating diagnosis and associated psychiatric comorbidities were not clinically confirmed. There are also potential biases that are associated with parent-reported measures of both the binge eating symptoms and screen time, physical activity, and sleep, including both overestimation and underestimation. In the future, actual measurements of physical activity and sleep could be obtained by accelerometers. Other limitations to our study include its cross-sectional design preventing a causal relationship to be deduced.

Conclusions

These novel findings have important implications for public health and clinical practice. First, the results emphasize the need to improve awareness and recognition of binge eating symptoms among children with overweight and obesity. The literature has suggested that specialized mental health and earlier group-based interventions may be effective in preventing disordered eating.⁴⁸ The findings also motivate the need for monitoring of these symptoms in child weight management interventions to ensure no adverse consequences occur and that the interventions seek to improve these symptoms. Our findings further suggest that recognition of binge eating symptoms in concurrence with health behaviors such as excess screen time or short sleep duration may yield a novel opportunity for a provider to address modifiable health behaviors and possibly reduce binge eating symptoms.

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Author Disclosure Statement

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