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Effect of Adapted Interpersonal Psychotherapy vs. Health Education on Mood and Eating in the Laboratory among Adolescent Girls with Loss of Control Eating

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Abstract

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Objective—Interpersonal psychotherapy (IPT) is aimed at improving negative affect that is purported to contribute to the development and maintenance of loss-of-control (LOC) eating. Although youth who report LOC over eating tend to consume more snack-foods than those without LOC, it is unknown if IPT impacts objective energy intake.

Methods—To test if IPT improves mood and eating in the laboratory, we examined a sample of 88 girls with LOC eating who were randomized to either IPT (n=46) or a standard-of-care health education (HE) group program. At baseline, and 6-month (follow-up 1) and 1-year (follow-up 2) following the initiation of the groups, girls consumed lunch from a multi-item meal with an instruction designed to model a LOC episode. Girls also reported mood state immediately before each meal.

Results—Girls in IPT experienced no significant changes in pre-meal state depressive affect, while girls in HE experienced a non-significant improvement by follow-up 1 and then returned to baseline by follow-up 2 ($p<.04$). We found no significant group difference for changes in total intake relative to girls' daily energy needs (p 's $.25$). However, IPT reduced, while HE increased, the percentage of daily energy needs consumed from snack-foods by follow-up 2 ($p=.04$). Within-groups, HE increased their snack food intake from follow-up 1 to follow-up 2 ($p=.01$).

Conclusions—In adolescent girls with LOC, IPT did not change total intake at the test meal and was associated with reduced snack-food intake. Data are required to determine if IPT effectively prevents excess weight gain in the longer-term.

Introduction

Pediatric loss of control (LOC) eating appears to be a shared risk factor for excessive weight gain¹⁻⁴ and binge eating disorder.^{5,6} Unlike classic binge episodes that are a hallmark feature of binge eating disorder and bulimia nervosa,⁷ LOC eating is characterized by a subjective lack of control over eating, regardless of the amount of food reportedly consumed.⁸ A well-phenotyped behavior, reported LOC is positively associated with negative mood states prior to eating and the consumption of snack foods even in the absence of an in vivo stressor.^{3,9} Therefore, intervening to reduce LOC episodes is an approach proposed to improve dysfunctional eating patterns, thereby decreasing obesity risk and preventing exacerbated disordered eating.¹⁰

One framework to explain LOC eating is interpersonal theory. The interpersonal model proposes that problematic relationships and poor communication lead to negative affective states that, in turn, result in binge¹¹ and LOC eating episodes.¹⁰ The interpersonal model is an extension of affect theory, which suggests that negative mood states trigger eating episodes that individuals use to escape from, or alleviate, adverse emotions.^{12,13} Affect theory has been supported in the laboratory in youth with LOC eating, through data illustrating that worse state negative mood in the absence of a in vivo stressor is linked to the consumption of more snack foods⁹ and reported experience of LOC while eating.¹⁴ However, no study has examined whether programs aimed at reducing reported LOC eating impact actual laboratory eating or the negative mood states that commonly precede LOC eating episodes. Given that non-intervention laboratory studies have demonstrated that youth with LOC consume more snack foods than those without LOC,¹⁵ and that negative mood

predicts the intake of such foods among adolescents with LOC,⁹ understanding if programs aimed at reducing LOC impact intake in the laboratory may provide a mechanism for changes in eating and weight outcomes.

Interpersonal psychotherapy (IPT), which is predicated on the interpersonal model,¹⁶ encourages the promotion of positive relationships and improvement of mood so that individuals are less likely to use food to cope.¹¹ Consistent with affect theory, IPT for eating disorders involves closely linking negative affective states to uncontrolled eating,¹¹ with the aim of attenuating the dysfunctional pattern of mood-induced eating described by the theory.^{12,13} Thus, IPT should presumably break the cycle of mood-induced eating and improve both state and trait negative affect. Moreover, because the IPT approach tightly links mood to LOC eating episodes, we expected that as mood improves and as adolescents recognize the connection between their mood and eating, that they would reduce snack food intake. Supporting this notion, IPT has demonstrated short- and long-term efficacy in adults to reduce binge eating.^{17–19} We carried out a randomized controlled trial testing the efficacy of an adapted prevention version of group IPT for the reduction of LOC eating and excess weight gain in high-risk adolescent girls.²⁰ Findings suggested that both IPT and a standard-of-care health education (HE) comparison program reduced LOC episodes and age-adjusted body mass index (BMI, kg/m²) metrics. Although unexpected that both programs improved weight trajectories, participants reduced gain during a developmental stage when girls typically increase body fat.²¹ Thus, elucidation of the mechanism of the programs is warranted. In the context of this trial, we also collected data to examine the components of the interpersonal model that involve affect theory to elucidate the underlying mechanism of the interventions. Specifically, girls reported their mood state and then were instructed to allow themselves to lose control while consuming lunch from a buffet meal before initiating, and again after completing, the prevention programs. Given that IPT addresses components of affect theory, we conducted a secondary analysis of the trial to examine the hypothesis that, compared to girls assigned to HE, those who received IPT would reduce both pre-meal state negative affect and subsequent consumption, especially of snack foods.

Methods

Participants

Healthy adolescent girls, age 12 to 17 years, were recruited for participation in a randomized controlled clinical trial ([ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT00680979) ID#: NCT00680979) at the Uniformed Services University of the Health Sciences (USU) and the National Institutes of Health (NIH) Hatfield Clinical Research Center in Bethesda, Maryland. Recruitment and inclusion and exclusion criteria are described in detail in a previous report.²⁰ In brief, participants were deemed at risk for excess weight gain and binge eating disorder because of a BMI between the 75th and 97th percentiles²² and the report of LOC eating in the past month.^{3,6} Individuals were excluded if they had a major medical or psychiatric condition (other than binge eating disorder), were simultaneously participating in a structured weight loss program or psychotherapy, or were taking medications known to affect body weight or appetite. The study was approved by the USU and *Eunice Kennedy Shriver* National Institute of Child Health and Human Development institutional review boards.

Procedure

Screening Visit 1—All patients underwent an outpatient screening visit, during which eligibility for the study was determined and consent and assent were obtained. The Eating Disorder Examination (EDE) version 14 OD/C.2²³ was administered to identify girls reporting at least one episode of LOC eating in the month prior to assessment and to screen out youth with current or past anorexia nervosa or bulimia nervosa. The presence of LOC eating was coded if youth reported any classic objective binge episodes (consumption of an unambiguously large amount of food accompanied by a sense of LOC over eating); any subjective binge episodes (the experience of LOC over eating while consuming an ambiguously large amount of food); or both. The EDE has demonstrated excellent internal consistency in adolescents for the presence and frequency of eating episodes.²⁴ As previously described, a standard protocol for interview administration²⁵ was used to facilitate objective and reliable assessment of disordered eating. Inter-rater reliability (intra-class correlations) for the frequency of LOC episodes in assessments conducted for this trial suggested good to excellent reliability.²⁰

Screening Visit 2 and Follow-Up Assessments—Girls were asked to fast overnight before attending a second screening visit (before starting the prevention programs) and for two follow-up visits (6 months, “follow-up 1” and 1 year, “follow-up 2”, following the initiation of the group programs). Participants were aware that they would be participating in a test meal and parents confirmed that their daughters consumed only water and no food during the overnight fast.

Anthropometrics

Girls’ height was measured three times to the nearest millimeter with a calibrated electronic stadiometer, and weight was measured to the nearest 0.1 kg with a calibrated digital scale. Weight and the average of the three heights were used to calculate BMI. The U.S. Centers for Disease Control and Prevention growth standards were used to convert BMI to z-scores and percentiles.²⁶ Body fat mass (kg) was assessed by dual-energy X-ray absorptiometry (DXA) using a Hologic QDR-4500A or Discovery instrument (Bedford, MA).

Pre-Meal State Negative Affect

At 11:00 AM, immediately before eating, girls completed the well-validated Brunel Mood Scale,²⁷ a 24-item self-report measure that assesses feelings “right now,” rated on a 5-point Likert scale ranging from 1=‘Not at all’ to 5=‘Extremely.’ The Brunel Mood Scale generates six subscales pertaining to anger, confusion, depression, fatigue, tension, and vigor. Only the adverse mood states subscales for anger, depression, and tension were examined for the present study. As recommended,²⁷ T-scores are used for analysis and interpretation.

Buffet Test Meal

Participants were then asked to consume their lunch from a multiple-item buffet with instructions designed to stimulate a LOC eating episode.²⁸ Girls were provided the recorded instruction to “let yourself go and eat as much as you want” and then were left alone in the room to eat *ad libitum* from the buffet. As previously described,²⁸ the buffet test meal was

comprised of 9,835 kcal with individual items that varied in macronutrient composition (12% protein, 51% carbohydrate, 37% fat across all foods) and contained a wide assortment of foods including dairy, meat, breads, snacks and desserts, drinks, condiments, fruits and vegetables. We defined the snack foods on the array to consist of: vanilla wafer cookies, chocolate sandwich cookies, jellybeans, chocolate candy, tortilla chips and pretzels.¹⁵ Each adolescent was instructed to inform a research assistant when she was finished eating. Amounts of food and beverage consumed were calculated by weighing each food or beverage item once before and once after the meal on digital Mettler Toledo and Ohaus balances to the nearest tenth of a gram. The balances were calibrated with external weights monthly. Energy content and macronutrient composition for each item were determined according to data from the U.S. Department of Agriculture Nutrient Database for Standard Reference as well as nutrient information supplied by food manufacturers.

Prevention Programs

As previously described,²⁰ in this parallel-group, controlled trial, participants were randomized to either the adapted version of IPT or the HE comparison group using computer-generated random numbers. The programs involved an individual 1.5-hour meeting with each girl followed by 12 consecutive weekly 90-minute group sessions. Leader training as well as program delivery and fidelity have been described.²⁰ In brief, each group was co-facilitated by a trained PhD-level clinical psychologist and a trained graduate student in clinical psychology. Ongoing weekly supervision, including review of audiotaped sessions, ensured intervention consistency and fidelity with the respective manuals.

Adapted Interpersonal Psychotherapy (IPT)

The IPT program was adapted from two previously established IPT manuals: i) IPT-Adolescent Skills Training for the prevention of depression²⁹ and ii) group IPT for binge eating disorder.¹¹ As previously described,²⁰ in our adapted program, girls were taught to identify the connections among their relationships, mood, and eating. By guiding them to improve their interpersonal interactions both within and outside of the group milieu, the goal of IPT is to reduce negative affect-induced LOC eating episodes that promote exacerbated binge eating and excess weight gain.

Heath Education (HE)

As previously described,²⁰ the HE intervention was based upon the “Hey-Durham” manual for high school students.³⁰ The HE program was effectively adapted, and previously delivered, as an attention comparison to match session duration and frequency of IPT.^{20,31} The curriculum topics include domestic violence, alcohol, drug and tobacco, basic information on nutrition, body image, symptoms and prevalence of depression and suicide, gang violence, non-violent conflict resolution, and sun safety. The single session on nutrition involved very basic education on nutrition and provided no guidance on linking mood to eating.

Statistical Analysis—Analyses were performed with SPSS® 19.0 using data from participants who completed test meals at all three intervals (baseline, follow-up 1, and

1 follow-up 2). Generalized linear models were used to compare IPT and HE groups at baseline on intake (total calories, calories from snack foods) and pre-meal negative mood states (anger, depression, tension). Due to significant positive skew, a gamma distribution with a log link function was used for all models except total energy intake (kcal), which was modeled with a normal distribution. To account for individual differences in energy needs, the total calories consumed by participants were calculated from the amount consumed, and this total was divided by each girl's estimated daily calorie needs to derive the percent of calorie needs consumed at each test meal. Daily calorie needs were estimated with age-specific formulas for calculating estimated energy requirements according to weight, age, height, and physical activity level.^{32,33} Generalized estimating equations (GEE) models were used to compare IPT and HE groups on intake and pre-meal state mood at follow-up 1 and follow-up 2, adjusting for baseline intake and mood. Distributions were comparable to those described above. Models included main effects for Group, Time, a Group $\times$ Time interaction, and a first-order autoregressive correlation matrix to account for repeated observations. Covariates for all models included race, baseline age, height, adiposity (kg), and any self-reported use of medication during the follow-up intervals that might potentially impact mood and/or energy intake (presence vs. absence), and baseline measurement of the dependent variable. GEE models were conducted separately in IPT and HE groups to evaluate within-group changes from baseline to follow-up 1, and from follow-up 1 to follow-up 2. Effects were considered significant at $p < .05$.

Results

Eighty-eight girls (78% of the original sample) who were randomized to IPT or HE completed the laboratory test meals at baseline, follow-up 1 and follow-up 2. At baseline, 108 of 113 girls participated in a test meal. Ninety-eight girls participated in the study through follow-up 2. The 10 girls who were not included in the present analysis developed a food allergy, became a vegetarian, or did not fast prior to attending an assessment that precluded their participation in the test meal portion of one or both follow-ups. These girls did not differ from those who participated in all three test meals on any baseline variable (age, number of LOC episodes, depressive symptoms, or total calories or snack foods consumed at the test meal, all $p > .43$) or based on group assignment ($p = .20$). As previously reported,²⁰ girls who did not complete the final 12-month follow-up had attended fewer group sessions as compared to those who were seen at 12-months (5 vs. 11 sessions attended, $p = .003$). Completers and dropouts did not differ significantly in race/ethnicity, socioeconomic status, baseline BMI-derived metrics, adiposity, or LOC eating episodes ($p > .14$). By design, all girls reported the presence of LOC eating, and the IPT and HE groups did not differ on any baseline demographic or anthropometric characteristic (Table 1). No significant differences at baseline were found between IPT and HE groups for pre-meal state negative affect (p 's $\geq .35$) or for intake (p 's $\geq .59$; Table 2).

Pre-Meal State Negative Affect

A significant Group $\times$ Time interaction (Wald $\chi^2 = 4.203$, $df = 1$, $p = .04$) was found for state depressive affect prior to eating. Despite a non-significant improvement from baseline to follow-up 1, depression scores returned to baseline in the HE group from follow-up 1

(estimated marginal mean = 44.00, SE = .20) to follow-up 2 (estimated marginal mean = 45.25, SE = .48). In contrast, depression scores in IPT were unchanged from follow-up 1 (estimated marginal mean = 44.05, SE = .33) to follow-up 2 (estimated marginal mean = 44.02, SE = .36) assessment (Figure 1). No Group $\times$ Time differences between IPT and HE were found for pre-prandial state anger (Wald $\chi^2 = .75$, df = 1, $p = .39$) or state tension (Wald $\chi^2 = .24$, df = 1, $p = .63$) at follow-up 1 or 2. As displayed in Table 2, the IPT group showed no significant within-group change in depression, but had significant reductions in tension and anger by follow-up 2. The HE group experienced significant within-group increases in depression from follow-up 1 to 2, with no changes in tension or anger.

Energy Intake

Total intake relative to energy requirements did not differ between IPT and HE at follow-up assessments (Wald $\chi^2 = 1.3$, df = 1, $p = .25$). In contrast, a significant Group $\times$ Time interaction (Wald $\chi^2 = 4.25$, df = 1, $p = .039$) was found for snack food intake relative to requirements. In the HE group, intake of snack foods increased from follow-up 1 (estimated marginal mean = 12.33, SE = 1.50) to follow-up 2 (estimated marginal mean = 15.09, SE = 1.45). For the IPT group, intake of snack foods decreased slightly from the follow-up 1 (estimated marginal mean = 11.69, SE = 1.63) to follow-up 2 assessment (estimated marginal mean = 10.45, SE = 1.39) (Figure 2). In order to determine whether differences between groups in the intake of snack foods was attributable to differences in mood, secondary analyses were conducted adding time varying covariates representing concurrent anger, depression, and tension to the above model. A significant effect was found for tension (est. = .024, SE = .011, $p = .027$) indicating that higher tension was associated with greater caloric intake of palatable food. The Group $\times$ Time interaction remained significant (Wald $\chi^2 = 4.93$, df = 1, $p = .026$) in the same direction as results from primary analyses. To determine if this result was being driven by the number of reported LOC episodes at each interval, we repeated the analysis including eating episodes at each time point as a time-varying covariate. The Group $\times$ Time interaction remained significant after adjusting for LOC episodes at each time point (Wald $\chi^2 = 3.99$, df = 1, $p = .046$). No significant within-group changes in total intake were found for either group (see Table 2 for within group-group results). Further, no significant within-group changes in snack food intake were found for the IPT group. By contrast, the HE group experienced a significant within-group increase in snack food intake from follow-up 1 to follow-up 2 ($p = .011$).

In follow-up analyses, we examined whether reports of the presence of classic binge episodes and LOC were linked to intake at the respective follow-ups. At follow-up 1, girls with LOC presence consumed more total ($p < .02$) and snack ($p < .04$) intake compared to those no longer reporting LOC. However, no differences were found based on binge presence at follow-up 1 or for LOC or binge presence at follow-up 2 ($p > .20$). The group interaction term at each time point was non-significant for total and snack intake ($p > .50$).

Discussion

In a sample of adolescent girls at high-risk for excess weight gain, we found that by 1 year follow-up (follow-up 2), girls who participated in a HE program returned to baseline pre-

meal state depressive mood and increased snack food intake. Comparatively, those who completed an adapted version of IPT showed no worsening of state depression or increased consumption of snack foods. Within group analyses showed that participation in IPT was associated with decreases in pre-meal state tension and anger at 1 year (follow-up 2). Findings suggest that IPT may prevent an exacerbation of the negative affect-uncontrolled eating link proposed by affect theory and may offer one mechanism through which IPT reduces LOC eating episodes and age-adjusted BMI metrics. Future research with a larger sample size is required to fully test this hypothesis.

In previously reported outcomes, we found that girls randomized to either IPT or HE experienced reductions in reported LOC episodes and objectively measured age-adjusted BMI and adiposity.²⁰ Moreover, the average *trait* depressive and anxiety symptoms of girls in both groups showed significant reductions. In the current analysis, using a controlled laboratory paradigm, girls randomized to HE showed an increase in state depressive mood prior to eating following an initial non-significant decrease, while those in IPT experienced no change in state pre-meal depression. Moreover, within the IPT group, girls reduced state tension and anger prior to eating, while no such reductions were observed for HE. Findings in *state* negative affect over time may be the result of intervention approaches. Both IPT and HE provide general social support, which has been shown to improve mood³⁴ and promote weight maintenance and loss.^{35,36} Yet, IPT also concentrates on making explicit links between proximal, momentary negative mood and subsequent LOC eating, and then focuses on improving relationships to attenuate the association.¹¹ While a fully-powered mediation model is required to determine whether IPT may be exerting a potentially positive effect by preventing a worsening of pre-meal negative mood states, findings should be interpreted cautiously as subscale T-scores from the Brunel Mood Scale were below 50 at each time point. Thus, while we observed statistically significant changes, scores were below clinical significance at every time point.

No difference was observed in total energy intake relative to requirements among girls randomized to either group. By contrast, a group by time interaction suggested that only girls in HE, as compared to those in IPT, significantly increased their intake of snack foods relative to requirements at 1 year (follow-up 2). As groups did not differ in overall food intake at any time point, it is possible that girls in HE changed the composition of their overall diet. Notably, at every time point, girls in both groups consumed more than the United States Department of Agriculture's recommended percent daily allowance of "empty calories" of nine percent for adolescent girls.³⁷ Therefore, despite the trending downward of consumption of snack foods in IPT girls by one year (from 13% to 11%) compared to the trending upward of HE (from 13% to 14% by one year), all participants still consumed too many "empty calories" at each test meal.

While our laboratory test meal served as a proxy for a real-time LOC episode, group differences in snack food intake did not parallel our previously reported findings that girls in both IPT and HE self-reported reductions in LOC episodes at six month and 1 year following the initiation of the programs.²⁰ Moreover, follow-up analyses showed that while the presence of reported LOC eating was linked to intake at six-months, by 1-year, there was no relationship between reported eating episodes and intake in either group. However, very

few girls reported aberrant eating by 1-year, limiting the statistical power of such analyses. By contrast, these laboratory data are consistent with our prior finding that IPT was more effective at reducing classic, reportedly large binge episodes than HE.²⁰ It is possible that laboratory feeding data may capture phenotypic changes in LOC eating that are not well assessed by interview. IPT involves practice in linking state mood to the experience of LOC eating regardless of the amount of food consumed. Without this training, girls assigned to HE may only connect the out of control experience to the consumption of objectively large amounts. By contrast, IPT may provide girls with the ability to recognize out of control eating regardless of the amount consumed.

If extended to affect theory, it is possible that IPT attenuated, or thwarted a strengthening of, the link between state negative mood and LOC eating, which resulted in an association with less snack food consumption. While these findings provide a mechanism for the reduction in LOC episodes and age-adjusted BMI indices for girls assigned to IPT, they do not provide an understanding of the previously reported similar changes experienced by the HE girls.²⁰ While social support provided by both groups may have resulted in improvements in the short-term, the effects of IPT on LOC eating and body weight may conceivably take longer for group differences to emerge. In fact, girls in HE appeared to experience improvements in mood and snack food intake at six-months, and then seemed to rebound to baseline levels at 1-year. It is possible that while IPT and HE are both effective in the short-term, IPT continues to promote improvements over time while HE does not exert sustained benefits. There are some adult data to suggest that IPT's impact on eating pathology takes longer than other programs³⁸ and one study demonstrated that group differences did not emerge until four years after therapy.³⁹ Indeed, improvements in state mood and maintenance of measurable, snack food intake may precede the translation of significant group differences in self-reported LOC eating and body weight.

Study strengths include its theoretical foundation, use of a comparison group matched for time and attention, and a racially/ethnically diverse sample. Moreover, we used a well-controlled laboratory test meal to assess food intake. Real-time and laboratory assessment may be an ideal approach to elucidate changes in eating behavior because they overcome biases in recall. However, the large buffet-style meal may also be considered a limitation. Although used effectively in prior studies,^{15,28,40} the paradigm may not capture eating behavior in the natural environment. Indeed, each test meal accounts for only one meal at each assessment interval. Additionally, given that each test meal included 28 food or beverage items, it was not feasible to impute missing data. Thus, findings should be interpreted as generalizable to only completers. Another limitation is the relatively short follow-up interval of one year. A longer follow-up interval may be needed to provide a mechanism for change for both programs. Lastly, future research with a sample size adequately powered for mediation analyses should examine whether mood state mediates the relationship between intervention and energy intake over time.

In conclusion, IPT may be more effective than HE in stabilizing pre-meal state affect and is associated with a decrease in palatable food consumption that characterize the LOC phenotype. Future research is required to determine whether findings from the laboratory predict longer-term eating and weight outcomes.

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Figure 1.

Between-groups, pre-meal state depressive affect prior to eating increased in the health education (HE) group from follow-up 1 (6 months) to follow-up (1 year), while state depression scores in the interpersonal psychotherapy (IPT) group were unchanged from the 6 month to 1 year assessment (Group $\times$ Time interaction, $p = 0.04$).

Figure 2.

For health education (HE), percentage of intake of snack foods relative to requirements significantly increased from follow-up 1 (6 months) to follow-up 2 (1 year). For interpersonal psychotherapy (IPT), intake of snack foods relative to requirements non-significantly decreased from the 6 month to the 1 year follow-up (Group $\times$ Time interaction, $p = 0.039$).

Table 1

Baseline demographics and anthropometrics of adolescent girls in interpersonal psychotherapy (IPT) and health education (HE) groups who were included in analysis

Variable	IPT (n = 46)	HE (n = 42)	P value
Age, years ¹	14.1 (1.5)	14.7 (1.8)	0.12
Race/ethnicity, n (%)			0.84
Non-Hispanic Black	12 (26.1%)	11 (26.2%)	1.00
Non-Hispanic White	24 (52.2%)	22 (52.4%)	
Hispanic	4 (8.7%)	4 (9.5%)	
Other	6 (13.0%)	5 (11.9%)	
Socioeconomic status ²	2.0 (1–5)	2.0 (1–5)	0.80
BMI ¹	26.8 (2.6)	27.2 (2.5)	0.54
BMI-z ¹	1.6 (0.5)	1.6 (0.5)	0.89
Body fat percent ¹	36.1 (5.0)	36.1 (5.2)	0.96

T-tests were used to analyze all continuous demographic variables and chi-squares for categorical variables.

¹Unadjusted mean (standard deviation).

²Median (range) of the Hollingshead Index.

Table 2

Within-groups changes in pre-meal negative state affects and energy intakes over time among adolescent girls in interpersonal psychotherapy (IPT) or health education (HE) groups

Variable	IPT (n = 46)		HE (n = 42)		Effect of time <i>p</i> value
	Baseline	Follow-up 1/6 months	Baseline	Follow-up 1/6 months	Follow-up 2/1 year
Pre-Meal BRUMS ¹					
Anger	45.8 (0.8) ^{a,b}	45.3 (0.5) ^{b,c}	46.2 (0.8)	45.6 (0.6)	45.43 (0.5)
Depression	44.9 (0.4)	44.5 (0.2)	45.5 (0.5) ^a	44.3 (0.1) ^b	45.5 (0.6) ^a
Tension	45.3 (0.7) ^a	44.0 (0.6) ^b	45.3 (0.8)	45.1 (0.9)	44.3 (0.8)
% Total intake (kcal) ²	51.8 (2.9)	49.1 (3.0)	54.3 (3.5)	51.5 (2.5)	56.0 (2.8)
% Snack food intake (kcal) ²	13.5 (1.9)	12.2 (1.5)	13.3 (1.8) ^{a,b}	12.2 (1.3) ^{b,c}	14.4 (1.4) ^a

Generalized estimating equations models were conducted separately in IPT and HE groups to evaluate within-group changes from baseline through follow-up. Means and standard errors are presented. Estimates differing in superscript letters are significantly different.

¹ Brunel Mood Scale.

² Relative to daily energy requirements based upon sex, age, BMI, and physical activity.