Published in final edited form as:

Appetite. 2016 December 1; 107: 330–338. doi:10.1016/j.appet.2016.08.098.

Developmental Trajectories of Compensatory Exercise and Fasting Behavior across the Middle School Years

Heather A. Davis, Leila Guller, and Gregory T. Smith

University of Kentucky

Abstract

Compensatory exercise and fasting behavior, in the absence of binge eating and purging, appear to be important eating disorder behaviors that are associated with dysfunction, but little is known about these behaviors in youth. We studied the trajectories of their development in non-binge eating and non-purging girls during early adolescence. Using a longitudinal design, we assessed 564 girls six times over the three years of middle school (grades 6 through 8) and developed trajectories specifying different developmental patterns in relation to the behaviors. Prior to this period, when the girls were in 5th grade (elementary school), we assessed risk factors to predict girls' subsequent trajectory group membership. Compensatory exercise trajectory groups included a non-engagement group, a group that increased in the behavior, and a group that decreased in the behavior. There were two fasting trajectory groups, one consistently engaging in the behavior and the other consistently not. Elementary school levels of depression, eating expectancies, and thinness expectancies predicted subsequent trajectory group membership. Risk for compensatory exercise and fasting should be evaluated as early as in 5th grade. Targeted interventions should focus on girls in late elementary school or middle school, as this appears to be a critical developmental and maintenance period for compensatory exercise and fasting behavior.

Keywords

eating disorders; compensatory exercise; fasting; adolescence

In recent years, researchers have identified the nonpurging compensatory eating disorder behaviors of compensatory exercise and fasting as harmful in adults, even when present in the absence of binge eating and purging (Davis, Holland, & Keel, 2014; Mond & Calogero, 2009; Tobin, Griffing, & Griffing, 1997; Wade & O'Shea, 2015). The construct of compensatory exercise represents exercising a great deal with the goal of altering weight, shape, or appearance, or to compensate for food intake that may affect weight or shape (Fairburn & Cooper, 1993; Holland, Brown, & Keel, 2014; Mond & Calogero, 2009). It is

Correspondence concerning this article should be addressed to Gregory T. Smith, Department of Psychology, University of Kentucky, 123 Kastle Hall, Lexington, KY 40506-0044. gsmith@email.uky.edu, or Heather A. Davis, Department of Psychology, University of Kentucky, 111-H Kastle Hall, Lexington, KY 40506-0044. h.davis@uky.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

The authors have no financial conflicts of interests to disclose.

distinct from both excessive exercise without a compensatory goal and compulsive exercise, which has the goal of preventing or reducing feelings of distress or continued exercise despite injury or illness (Holland, Brown, & Keel, 2014).¹ Fasting is generally defined as not eating for at least 8 waking hours for the purpose of controlling one's weight and/or shape (Cooper & Fairburn, 1987). These behaviors do occur in the context of established eating disorders (bulimia nervosa; BN; anorexia nervosa; AN). Importantly, however, they also seem to occur in the absence of AN and BN diagnoses.

Among adults, these two behaviors in the absence of binge eating and purging are associated with body image disturbance (Davis et al., 2014), anxiety (Davis et al., 2014), functional impairment (Mond et al., 2006), and increased likelihood of psychiatric hospitalization (Tobin et al., 1997). These findings suggest that nonpurging compensatory eating disorder behaviors merit the attention of researchers and clinicians. One important line of inquiry concerns when these behaviors emerge developmentally, whether different individuals progress along different trajectories of engagement in the behaviors over time, and whether early engagement in these behaviors is associated with significant harm.

To date, research on these behaviors in adolescents has indicated the following. Both compensatory exercise and fasting appear to be prevalent in adolescence (Eddy, Doyle, Hoste, Herzog, & le Grange, 2008; Machado, Machado, Gonçalves, & Hoek, 2007). Most often, engagement in the behaviors is studied in girls who are also engaging in binge eating and purging. In that context, the behaviors are associated with anxiety and depression (Allen, Crosby, Oddy, & Byrne, 2013; Stiles-Shields, Goldschmidt, Boepple, Glunz, & le Grange, 2011), substance abuse (Pisetsky, May Chao, Dierker, May, & Striegel-Moore, 2008), suicidal ideation (Crow, Eisenberg, Story, & Neumark-Sztainer, 2008) and social distress (Neumark-Sztainer, Wall, Story, & Perry, 2003). In the context of AN, driven exercise (this term is closely related to compulsive exercise and is defined as intense exercise with a compulsive quality: Fairburn, Cooper, & O'Connor, 2008) is associated with poorer treatment outcomes (Stiles-Shields, Bamford, Lock & le Grange, 2015). Wade and O'Shea (2015) identified adolescent girls engaging in driven exercise and fasting but not binge eating and purging; they found that those girls experienced significant distress that was comparable to that of girls diagnosed with typical or atypical AN.

Because eating disorder symptoms often emerge during the middle school years (grades 6-8 in the current sample; Bulik, 2002; Pearson, Zapolski, & Smith, 2015a), it is important to understand the presence and developmental course of nonpurging compensatory behaviors in girls this age. We therefore investigated if these behaviors occur in girls during the middle school years, whether engagement in the behaviors follows different developmental courses for different girls across those years, and whether it was possible to predict the behaviors from the presence of elementary school risk factors. We studied these behaviors in the absence of binge eating and purging, in order to evaluate their emergence and their associations with dysfunction independent of binge eating and purging.

¹One study compared these three forms of exercise in adults, and found that both compensatory exercise and compulsive exercise relate to disordered eating symptoms, whereas excessive exercise alone does not (Holland et al., 2014). We chose to study compensatory exercise because it related most strongly to multiple disordered eating symptoms.

To predict these behaviors, we studied four risk factors. The first was depressive symptomatology, which tends to co-occur with eating pathology (Godart et al., 2007; Santos, Richards, Bleckley, 2007) and is a risk factor for the development of disordered eating in the transition from childhood to adolescence (Ferreiro, Wichstrom, Seoane, & Senra, 2014). The second was the expectancy that eating helps manage negative affect, and the third was the expectancy that thinness leads to overgeneralized life improvement (Hohlstein, Smith, & Atlas, 1998). The fourth risk factor was pubertal onset.

We studied the two types of expectancies as risk factors for two reasons. First, expectancies are understood to be summaries of individuals' learning histories. They guide future behavioral choices because they are learned anticipations of the likely consequences of possible behaviors (Goldman, Brown, Christiansen, & Smith, 1991). Eating and thinness expectancies are understood to be precursors to other important eating disorder risk factors (Pearson, Wonderlich, & Smith, 2015b). Endorsement of the expectancy that eating helps manage negative affect can be understood to reflect a summary of learning experiences relating eating to negative reinforcement that contributes to emotional eating, and hence to loss of control eating. Endorsement of the expectancy that thinness leads to overgeneralized life improvement reflects a summary of learning experiences relating thinness to a wide range of reinforcers, and thus contributes to internalization of the thin ideal as well as body dissatisfaction that so frequently results from comparisons of the self to the ideal (Pearson et al., 2015b).

Second, there is good reason to think that expectancies for reinforcement from eating and from thinness relate to nonpurging compensatory behaviors. Strong endorsement of the expectancy that thinness brings overgeneralized life improvement could well precipitate engagement in behaviors such as compensatory exercise or fasting. Endorsement of expectancies for reinforcement from eating relates to excessive food consumption (Simmons, Smith, & Hill, 2002), which can increase the likelihood of behaviors such as compensatory exercise or fasting. It is perhaps relevant that the two expectancies predict the subsequent onset of, and increases in, binge eating and purging in adolescent girls and boys (Pearson, Combs, Zapolski, & Smith, 2012; Smith, Simmons, Flory, Annus, & Hill, 2007).

The fourth risk factor we studied was pubertal onset, which has been shown to be related to heritable risk for bulimic behaviors (Culbert, Burt, McGue, Iacono, & Klump, 2009). To our knowledge, no prior study has examined the effect of pubertal status on the development of nonpurging compensatory behaviors in the absence of binge eating and purging in adolescent girls. Thus, we viewed investigation of this risk factor as exploratory.

The Current Study

We conducted a series of trajectory analyses on a sample of non-binge eating and non-purging adolescent girls across six time points over the three years of middle school. Trajectory analysis is a statistical method that seeks to identify different subgroups of girls who proceed along different developmental pathways over time (Nagin, 2005). We studied compensatory exercise and fasting separately. We had no a priori hypothesis for what

trajectories would emerge because little is known about the developmental course of these behaviors over time.

To determine if engagement in, or the development of, compensatory exercise and fasting behaviors can be predicted from risk factors measured earlier in time, we tested whether depressive symptoms, eating and thinness expectancies, and pubertal onset, measured in elementary school, six months prior to the start of the trajectory period, predicted trajectory group membership. To determine if ongoing engagement in these behaviors is associated with dysfunction, we tested whether group membership was associated with depressive symptoms, eating expectancies, and thinness expectancies at the end of the trajectory period. We did not assess pubertal development at the end of the trajectory period because most girls will have gone through puberty by the end of 8th grade. Finally, we examined joint trajectories. This step involves specifying trajectories based on change over time in both behaviors.

Method

Sample

Participants were drawn from a longitudinal sample of 938 girls who were assessed at seven time points: Spring of the last year of elementary school (5th grade; Wave 0), and fall and spring of each year of middle school, or 6th through 8th grades (Waves 1-6). The mean age of the participants at the initiation of the study was 10.33 years. Most were European American (60.9%), followed by African American (18.7%), Hispanic (8.2%), Asian (2.9%), Middle Eastern (0.4%), and other (8.8%). To study the presence and development of compensatory exercise and fasting behavior in the absence of binge eating and purging in these youth, we selected a subsample comprising all participants who did not report binge eating or purging during any of the seven waves. The subsample included 564 girls and it did not differ from the larger sample on any demographic variable (age, race, ethnicity, or socioeconomic status).

Measures

Demographic and Background Questionnaire—This measure provided the assessment of the demographic information reported above.

Eating Disorder Examination-Questionnaire—(EDE-Q; Fairburn & Beglin, 1994). We used three questions from the child adaptation of the EDE-Q, which is a self-report version of the Eating Disorders Examination semi-structured interview (Cooper & Fairburn, 1993) to assess fasting and compensatory exercise. The EDE-Q has been shown to have good reliability and validity, particularly in clinical samples (Cooper & Fairburn, 1993; Luce & Crowther, 1999; Mond, Hay, Rodgers, Owen, & Beumont, 2004). Following existing recommendations for use of the measure with youth, we adapted the EDE-Q by using age-appropriate wording, defining concepts that could possibly be difficult to understand, and shortening the length of time referred to in the questions to the past two weeks (Carter, Stewart, & Fairburn, 2001). We measured compensatory exercise with a sequence of two questions. The first was “Over the past two weeks, have you exercised a lot as a way to

control your weight or because you ate a lot?” The item was dichotomous. Participants who responded “yes” then completed a second item: “If yes, on how many days of the last 14 have you done this?” There were six response options, ranging from “1-2 days” through “14 days or every day.” We combined the two items, such that 0 reflected no compensatory exercise, 1 reflected having done so 1-2 days of the last 14, and so on. To measure fasting behavior, we used the item “Over the past two weeks, have you gone for long periods of time (8 hours or more) without eating in order to control your shape or weight?” Responses were dichotomous.

Center for Epidemiological Studies-Depression Scale—(CES-D; Radloff, 1977) was used to measure individual differences in depressive symptomology. The scale has proven reliable and valid in numerous studies. It is frequently used with children and adolescents, just as it is used with adults (Radloff, 1977; Miller, Anton, & Townson, 2008). The possible range of scores is zero to 30, with higher scores indicating more depression symptoms in the previous week (Radloff, 1977). We used CES-D scores as interval scale indicators of depression symptoms ($\alpha = .85$ in Wave 1 and higher in subsequent waves). Test-retest reliability was .87 in one study (Miller et al., 2008).

Eating Expectancy Inventory—(EEI; Hohlstein et al., 1998). From this 5-factor, Likert format measure, we used the 8-item subscale reflecting the expectancy that eating helps one manage negative mood states. Total scores range from 8 to 32. Higher scores indicate greater endorsement of the expectancy that eating alleviates negative affect. This scale has been shown to relate to disinhibited eating following attempts to diet (Simmons et al., 2002) and to predict the subsequent onset of binge eating (Pearson et al., 2015a; Smith et al., 2007). In the current sample the scale was internally consistent (Wave 1 $\alpha = .93$ and higher in subsequent waves).

Thinness and Restricting Expectancy Inventory—(TREI; Hohlstein et al, 1998). This measure reflects overgeneralized expectancies about the life benefits of dieting and thinness. The youth version is a short form consisting of 8 items in Likert format, chosen to represent the full content domain of the longer scale and maintain high internal consistency. There is considerable evidence for the reliability and validity of the short form (Pearson et al., 2012, 2015a). Total scores range from 8 to 32, with higher scores indicating greater endorsement of the expectancy that dieting and thinness lead to a better life. Items include such statements as “I would feel like I could do whatever I wanted to if I were thin.” The scale has been shown to be unidimensional. It relates to cognitive restraint of food consumption (Simmons et al., 2002) and it predicts eating disorder symptom onset (Pearson et al., 2015a; MacBrayer, Smith, McCarthy, Demos, & Simmons, 2001; Smith et al., 2007). Scores were internally consistent in this sample (Wave 1 $\alpha = .91$ and higher in subsequent waves).

The Pubertal Development Scale—(PDS; Petersen, Crockett, Richards, & Boxer, 1988). The PDS consists of four questions in a Likert-type rating format. Scores for these questions range from 4 to 16. An example item is “Has your skin started to change yet?” Participants were also asked if they had begun to have their period. This measure correlates

highly with physician ratings and other forms of self-report (Coleman & Coleman, 2002). As is common, we dichotomized pubertal status (Little & Rubin, 1989). Scores were internally consistent in this sample ($\alpha = .99$ at each wave).

Procedure

Data collection—Each wave, the questionnaires were administered in public schools during school hours (23 elementary schools at Wave 0; 15 middle schools at Waves 1-6). A passive consent procedure was used. Each family was sent a letter, through the U.S. Mail, introducing the study. Families were asked to return an enclosed, stamped letter or call a phone number if they did not want their child to participate. Out of 976 students whose families were approached by letter, 96%, or 938, of the students participated in the study. Reasons for non-participation were as follows: Families declined participation for their child, students declined assent, or a variety of other reasons, such as language disabilities that precluded completing the questionnaires.

Data collections took place in the spring of 5th grade and then the fall and spring in the three consecutive years of 6th, 7th, and 8th grades (the three years of middle school in the participating school systems). Questionnaires were administered in school classrooms or cafeterias at all waves. It was made clear to the students that their responses to the measures were to be kept confidential and no one outside of the research team would see them. The research team introduced the federal certificate of confidentiality for the project (this certificate is issued by NIH) and emphasized that they were legally bound to keep all responses confidential. After each participant signed the assent form, the researchers then passed out packets of questionnaires. Participants who moved out of the study's school districts were contacted and asked to complete the forms by mail and were paid \$30 for doing so. The questionnaire administration took 60 minutes or less. This procedure was approved by the University's IRB and by the participating school systems. There was no compensation for participants (except for those who moved out of district).

Data analytic method—Frequencies and correlational tests were calculated in advance of all other statistical tests. We used group-based trajectory models to examine trajectories of the development of compensatory exercise behavior and fasting behavior across the six waves capturing the three middle school years. We applied finite mixture modeling (Nagin, 2005), using SAS Version 9.1 PROC TRAJ, to model trajectories as a function of measurement wave. When using this method, one assumes that the target population can accurately be described as a mixture of distinct groups defined by their longitudinal trajectories. In brief, longitudinal data are used to identify the number of groups that best fit the data and to describe the shape of the trajectory for each group. Based on an individual's endorsement of a behavior over time, the probability of belonging to each potential trajectory group is estimated.

For the compensatory exercise trajectory model, we used zero inflated poisson (ZIP) modeling because a large number of participants reported no compensatory exercise, thus leading to a high number of zero responses. We understood non-zero responses as reflecting a count scale indicating the frequency of compensatory exercise behavior in the previous two

weeks at each assessment wave.² For the fasting behavior trajectory model, we used Bernoulli (LOGIT) modeling because responses to the fasting item were based on a dichotomous scale indicating the absence or presence (0/1) of fasting in the previous two weeks at each assessment wave.

Several fit indices are used as part of the process of determining the optimal number of groups and the validity of the grouping result. The Bayesian Information Criterion (BIC), sample size adjusted BIC (aBIC), and the Akaike Information Criterion (AIC) become increasingly less negative with improvements in the fit of the group structure. Those statistics can be supplemented by additional statistics and guidelines for selecting the best trajectory solution. For example, the Bayes rule (Nagin, 2005) permits estimation of when the difference between two BIC values is large enough to be meaningful. In addition, when the average probability of group membership is greater than .70 for each group (Nagin, 2005), the identified group structure is thought to fit well. One also avoids group structures with extremely small group sizes, out of concern for the stability of the structure (Nagin, 2005). In addition to these statistics, the final choice of trajectory solution is based on the meaningfulness of the distinctions among the groups (Nagin, 2005).

We examined trajectory slopes and, where appropriate, quadratic trends to determine significant change in behaviors over time. We constructed a 95% confidence interval around each linear slope or quadratic trend and determined whether it included zero.

To investigate whether risk factors predicted trajectory group membership, we used the PROC TRAJ RISK logistic prediction procedure. This method tests whether a given risk factor is associated with the probability of membership in a given trajectory group in comparison to a reference trajectory group. As we describe below, the reference groups in the current study were the low level compensatory exercise and the low probability of fasting groups.

To investigate the development of compensatory exercise and fasting behavior concurrently, we also conducted a joint trajectory analysis. This procedure constructs trajectory groups considering the two behaviors together. It thus facilitates description of variation in patterns of change across middle school in the two behaviors jointly.

Results

Participant Attrition Analysis and Treatment of Missing Data

The percentage of the sample who participated ranged from 97.5% at Wave 0 and 94.56% at Wave 1 to 82.10% at Wave 6.³ Analyses of variance comparing those who participated and those who did not on all study variables indicated no significant differences. Thus, data appeared to be missing at random, and we used the expectation maximization procedure to impute values for the missing data points. This procedure has been shown to produce relatively unbiased population parameter estimates and to be superior to traditional methods,

²We also modeled the compensatory exercise trajectories using an alternative method that treats the exercise variable not as a strict count, but rather as an ordered categorical variable. Results were identical.

³Retention from one wave to the next ranged from a low of 94.2% to a high of 99.3%.

such as deleting cases with missing data or conducting mean substitutions for missing values (Little & Rubin, 1989). As a result, we were able to make full use of the sample of 564.

Possible Effects due to School Membership

In order to determine whether there was significant covariance among the study variables due to participants attending the same school, we calculated intraclass coefficients for each variable (using elementary school membership, assessed at Wave 0, $n = 23$, as the nesting variable). Intraclass coefficients ranged from .03 to .00. We therefore concluded that school membership was essentially unrelated to study variables.

Descriptive Statistics

Table 1 presents the frequency of compensatory exercise and the presence of fasting over the two weeks preceding the assessments. As the table shows, at each wave, over 19% of girls reported at least some compensatory exercise and nearly 5% of girls reported fasting over the preceding two weeks. Table 2 provides the means and standard deviations for depression, eating expectancies, and thinness expectancies at Wave 0, as well as the percentage of girls who had experienced pubertal onset. Table 3 presents bivariate correlations among all study variables at Wave 0.

Developmental Trajectories of Compensatory Exercise

We used Nagin's (2005) procedure to determine (a) whether individual differences in girls' trajectories of compensatory exercise could be characterized in terms of subgroups; (b) what number and shapes of trajectory groups best summarize the data; (c) whether the risk factors of elementary school depressive symptomatology, pubertal status, eating expectancies, and thinness expectancies predicted the probabilities of trajectory group membership; and (d) how the trajectory groups differed on those risk factors at the end of the trajectory period (Wave 6, the end of middle school).

Compensatory Exercise Trajectories: Selection of Trajectory Model—The BIC, aBIC, and AIC values became progressively less negative from the 2-group solution to the 3-group to the 4-group solution, and application of the Bayes rule suggested each level of improvement was meaningful. However, the 4-group solution included groups with very small samples sizes and did not involve groups with substantively different trajectories from those apparent in the 3-group solution. We therefore adopted the 3-group solution. The 3-group solution for compensatory exercise among girls had average group membership probabilities from .87 to .96. Comparisons between compensatory exercise trajectory models are shown in the top half of Table 4.

Compensatory Exercise Behavior Trajectories—As shown in the top panel of Figure 1, of the 564 girls, 343 consistently reported very little compensatory exercise behavior across the 3-year, 6-wave trajectory period and had a high probability of placement in this group. Still, the rate of linear increase for this group was statistically significant: $t(1, 563) = 3.54$, $p < .001$, $b = 0.32$ (95% confidence interval (CI): 0.14, 0.49). It appears that as these girls progressed through middle school, they became a little more likely to engage in exercise behavior to control weight or shape, but did not do so at a high level, as the average

value in the spring of 8th grade is still near zero. This group is referred to the “low level compensatory exercise group.” A relatively large number of girls ($n = 152$) had a high probability of membership in what we refer to as the “decreasing group.” The average girl affiliated with this group reported compensatory exercise to control shape or weight three to four times in the past two weeks at the start of 6th grade, and the behavior appeared to drop to less than one time per week by 8th grade. The rate of linear decrease for this group was statistically significant, $t(1, 563) = -6.88$, $p < .001$, $b = -0.36$, 95% CI: $-.26, -.46$. A smaller group of girls ($n = 69$) had a high probability of membership in the “increasing group.” Their engagement in compensatory exercise increased across the six measurement waves. The pattern of increase followed a combination of a significant linear trend ($t(1, 563) = 3.45$, $p < .001$, $b = 0.89$, 95% CI: $0.38, 1.40$), quadratic trend ($t(1, 563) = -3.54$, $p < .001$, $b = -0.79$, 95% CI: $-0.35, -1.22$) and cubic trend, ($t(1, 563) = 3.45$, $p < .001$, $b = 0.19$, 95% CI: $0.08, 0.30$). At the start of 6th grade, they were engaging in virtually no compensatory exercise and were not distinguishable from the low-level compensatory exercise trajectory group. However, by the end of 8th grade, the average girl affiliated with the increasing compensatory exercise trajectory group reported compensatory exercise to control weight or shape three to four times in the past two weeks.

Risk Factors for Compensatory Exercise Group Membership—The low level compensatory exercise trajectory group was the reference group for membership in the decreasing and increasing trajectory groups. Wave 0 (5th grade) pubertal onset did not increase the likelihood of subsequent membership in the increasing (OR = 1.82, $p > .11$, CI: 0.88, 3.78) or decreasing (OR = 1.35, $p > .28$, CI: 0.78, 2.32) compensatory exercise groups, compared to the low-level compensatory exercise group. Increased levels of depression symptoms in Wave 0 had a predictive effect on probability of membership in the decreasing compensatory exercise group (OR = 1.03, $p < .04$, CI: 1.001, 1.06) such that for every one unit increase in depressive symptoms (the possible range of depression scores was 0 – 30), the probability of being in the decreasing compensatory exercise group, relative to the low-level compensatory exercise group, increased by 3%. Wave 0 depression did not have a significant effect on probability of membership in the increasing group (OR = 1.03, $p > .21$, CI: .98, 1.08). Lower expectancies for reinforcement from eating in Wave 0 predicted the probability of membership in the increasing compensatory exercise group (OR = -0.71 , $p < .04$, CI: $-0.49, -1.04$). Youth associated with a pattern of not engaging in compensatory exercise at the start of middle school but engaging in the behavior by the end of middle school had lower expectancies for reinforcement from eating in elementary school than did youth who tended never to engage in compensatory exercise. There was no effect of eating expectancies associated with the probability of membership in the decreasing compensatory exercise group (OR = 1.06, $p > .55$, CI: 0.88, 1.27). Higher levels of thinness expectancies in Wave 0 predicted the probability of membership in the decreasing compensatory exercise group (OR = 1.33, $p < .001$, CI: 1.15, 1.54), but not the increasing compensatory exercise group (OR = 1.06, $p > .63$, CI: 0.85, 1.32).

Trajectory Group Differences on Risk Factors at end of Trajectory Period—Probability of membership in the increasing compensatory exercise trajectory group was associated with higher levels of depression at Wave 6 (OR = 1.05, $p < .03$, CI: 1.01, 1.10),

but there was no relationship between Wave 6 depression and probability of membership in the decreasing compensatory exercise group ($OR = 1.01$, $p > .47$, $CI: 0.98, 1.05$). Higher levels of eating expectancies in Wave 6 (8th grade) predicted membership in the decreasing compensatory exercise group ($OR = 1.58$, $p < .002$, $CI: 1.19, 2.11$). Eating expectancies in 8th grade were not significantly associated with membership in the increasing compensatory exercise group ($OR = 1.13$, $p > .55$, $CI: 0.75, 1.72$). Higher levels of thinness expectancies in Wave 6 predicted membership in the increasing compensatory exercise group ($OR = 1.34$, $p < .02$, $CI: 1.04, 1.72$) but not the decreasing compensatory exercise group ($OR = 1.17$, $p > .11$, $CI: 0.96, 1.42$).

Developmental Trajectories of Fasting

We again used Nagin's (2005) procedure to determine (a) whether individual differences in girls' trajectories of fasting could be characterized in terms of subgroups, (b) what the number and shapes of the fasting trajectory groups were, and (c) whether probability of membership in the trajectory groups was associated with the risk factors of depressive symptomatology, eating expectancies, and thinness expectancies in Wave 0 and Wave 6, and pubertal onset in Wave 0 (5th grade).

Fasting Trajectories: Selection of Trajectory Model—As noted above, we conducted trajectory analyses on six semi-annual time points. The 3-group solution produced BIC, aBIC, and AIC values that reflected worse fit than those of the 2-group solution and included groups with very small samples sizes. We therefore adopted a 2-group trajectory solution. The 2-group solution for fasting among girls had average group membership probabilities from .85 to .94. Thus, there were clear, straightforward associations between youth and trajectory groups. Comparisons between fasting trajectory models are shown in the bottom half of Table 4.

Fasting Behavior Trajectories—As shown in Figure 1, bottom panel, 501 of the 564 girls reported little to no fasting behavior at each of the six semi-annual trajectory data collections spanning the period from the fall of 6th grade through the spring of 8th grade. The rate of change for the little to no fasting trajectory group was not statistically significant: $t(1, 563) = -1.45$, $p > .15$. A group of approximately 63 girls had high probability of membership in a trajectory group characterized by consistent reports of fasting behavior across the six trajectory measurement waves. Thus, a small subset of girls, none of whom engaged in binge eating or purging, consistently reported fasting for eight or more hours to control their shape or weight during the two weeks preceding the assessment. The rate of change in presence of fasting for the fasting group was not statistically significant: $t(1, 563) = .32$, $p > 0.75$. This pattern is striking: the fasting group was already engaging in fasting behavior at the start of middle school, and engagement in this behavior persisted over the developmental period. We found no evidence of a group that initiated fasting behavior during middle school.

Risk Factors for Fasting Group Membership—Probability of membership in the fasting group was predicted by elementary school depressive symptoms ($OR = 1.09$, $p < .001$, $CI: 1.05, 1.14$) and expectancies for reinforcement from thinness ($OR = 1.22$, $p < .04$,

CI: 1.001, 1.53). Neither pubertal status (OR = 1.23, $p > .70$, CI: 0.53, 2.87) nor expectancies for reinforcement from eating (OR = 0.92, $p > .60$, CI: 0.67, 1.26) related to the probability of fasting group membership.

Trajectory Group Differences on Risk Factors at end of Trajectory Period—

Wave 6 depressive symptoms (OR = 1.07, $p < .005$, CI: 1.02, 1.13) and thinness expectancies (OR = 1.52, $p < .001$, CI: 1.19, 1.94) were related to probability of membership in the fasting trajectory group, but Wave 6 eating expectancy endorsement was not (OR = 0.97, $p > .88$, CI: 0.64, 1.46).

Covariation between Compensatory Exercise and Fasting Trajectory Group Membership

We conducted joint trajectory analysis to gain information on the covariance of likely membership in both the compensatory exercise and fasting groups. As Table 5 shows, just over half of the girls (55.9%) were estimated to be in the consistently asymptomatic trajectory groups for both behaviors. Among the girls projected to be in the little to no fasting trajectory group, 80% were in either the low-level compensatory exercise or decreasing compensatory exercise group. Among girls projected to be in the increasing compensatory exercise group, 72.4% were projected also to be in the fasting group, whereas only 21.1% of girls projected to be in the decreasing exercise group were projected to be the fasting group.

Discussion

The current study is the first to identify longitudinal patterns of engagement in compensatory exercise and fasting behavior in middle-school aged girls. We found that (a) different longitudinal patterns of compensatory exercise and fasting occurred in girls as they developed through middle school; (b) the probability of membership in trajectory groups characterized by engagement in compensatory exercise and fasting could be predicted in advance from elementary school levels of depressive symptoms, expectancies for reinforcement from eating, and expectancies for reinforcement from thinness; (c) at the end of the trajectory period, probability of membership in trajectory groups characterized by engagement in compensatory exercise or fasting behavior was clearly associated with dysfunction; and (d) compensatory exercise and fasting covaried moderately, such that engagement in one of the behaviors increased the likelihood that one was engaging in the other.

With respect to compensatory exercise, one broad conclusion from this study is that early adolescent girls appear to progress along different trajectories over time with respect to this problematic behavior. Applying a developmental psychopathology perspective, it appears to be valuable to apply a person-centered approach to understanding both the increase and the decline of this behavior during the middle school years. Analytic methods that presume the pattern of change over time is the same for all adolescent girls risk providing incomplete information about the course of compensatory exercise.

On a more specific level, two of the identified groups were asymptomatic at the start of middle school: the larger group remained asymptomatic throughout middle school, whereas

the other group reported increasing engagement in compensatory exercise across those years. Of the four risk factors we studied in elementary school prior to the trajectory period, one differentiated between those groups: the group whose compensatory exercise increased over time in middle school reported fewer expectancies for reinforcement from eating in elementary school. Perhaps the pattern of less reward associated with food and early engagement in compensatory exercise may speak to risk for the development of restricting-based disordered eating problems. Further research, using additional risk factors, may prove useful in identifying characteristics that distinguish between those two groups.

The group characterized by elevated levels of compensatory exercise and then a decrease in the behavior over the middle school years had higher levels of depressive symptomatology and stronger endorsement of expectancies for reinforcement from thinness in elementary school. By comparison, the increasing group was characterized by more depressive symptoms and thinness expectancies not at the start of the trajectory period, but at its end, in 8th grade. It appears that elevations in depressive symptoms and thinness expectancies are associated with temporally proximal engagement in compensatory exercise. Interestingly, higher levels of eating expectancies in 8th grade was associated with the probability of membership in the decreasing compensatory exercise trajectory group, suggesting that despite their decline in compensatory exercise behavior engagement by 8th grade, they still endorsed the expectancy that eating helps alleviate their negative affect.

Strikingly, a subset of girls was engaging in fasting behavior at the beginning of middle school. These girls continued to engage in the behavior throughout the 3-year period of the study. We did not find the middle school years to be an important developmental period for fasting; rather, we found the behavior to be present at the start of middle school and stable throughout that period. As was true for girls engaging in compensatory exercise, there was a clear indication that girls mostly likely to be in this group tended to be distressed: six months prior to the trajectory period, the probability of their membership in the fasting group could be predicted by higher levels of depressive symptomatology and stronger endorsement of expectancies for overgeneralized life improvement from thinness than other girls.

The findings of this study are important clinically. Middle school girls engaging in compensatory exercise or fasting behavior have higher depression scores and more strongly endorse high-risk eating and thinness expectancies while in elementary school than girls who do not engage in the behaviors. Recently, Davis and colleagues (2016) reported that girls who engage in compensatory exercise or fasting in the absence of binge eating and purging had similar levels of depression as girls engaging in purging and low rates of binge eating. Girls engaging in these behaviors deserve the attention of parents, primary care physicians, and eating disorder clinicians. Parents of adolescent girls may consider taking note of motivations for, and patterns of, exercise engagement as well as eating habits. In addition, the behaviors themselves tend to be harmful.

We highlight three implications of this set of findings. The first is the importance of risk assessment in children at least as young as elementary school. Some girls are engaging in the problematic behaviors of compensatory exercise and fasting from the beginning of

middle school. The second is the need to include additional markers of risk in order to better anticipate problematic developmental trajectories of engagement in these behaviors. The third is that it may be valuable to investigate ways to disrupt these behaviors during these early, formative years. Thus, research to develop targeted interventions for these nonpurging compensatory behaviors might well prove useful.

An additional question is whether compensatory exercise and fasting should be understood as indicators of a common, nonpurging compensatory behavior disorder. In this early adolescent sample, the two behaviors covaried. Strikingly, many of the girls in the fasting group also belonged to trajectory groups characterized by either high levels of 6th grade compensatory exercise that then declined or the development of high levels of compensatory exercise by the end of 8th grade. The two behaviors serve the similar purpose of weight and shape management. On the other hand, there were many girls who engaged in one behavior but not the other. The decision of whether to combine the two behaviors into a common, nonpurging compensatory behavior syndrome merits further inquiry.

It is of course possible that early engagement in nonpurging compensatory behaviors leads to the subsequent emergence of purging and binge eating behaviors. Because we selected girls who had not engaged in purging or binge eating for our trajectory analysis, we could not assess that possibility. Thus, this study does not address this possibility. Perhaps a longer longitudinal window would have revealed the emergence of binge eating or purging among some girls engaging in nonpurging compensatory behaviors during middle school. It is noteworthy, though, that a substantial number of girls engaged in compensatory exercise or fasting over the 3-year period of middle school without initiating purging or binge eating behavior. Future, longer-term research on this question is clearly necessary.

The findings of this study should be considered in light of its limitations. First, all risk and behavioral symptom data were self-reported by questionnaire. Although the measures used demonstrated good psychometric properties in this and previous studies of adolescents, face-to-face interviews provide the opportunity for clarification of terms, which may be particularly useful in a sample of youth. Second, we did not include a measure of body mass index (BMI) and so were not able to test the possibility of BMI's prediction of nonpurging compensatory behaviors in the current study. Previous studies indicate that overweight youth are at increased risk for unhealthy weight control behaviors (Neumark-Sztainer, Story, Falkner, Beuhring, & Resnick, 1999; Neumark-Sztainer et al., 2003). However, BMI did not discriminate between girls who did and did not engage in nonpurging compensatory behaviors in prior work (Stiles-Shields, Labuschagne, Goldschmidt, Doyle, & le Grange, 2012; Wade & O'Shea, 2015), although Neumark-Sztainer et al. (1999) did find that girls with low BMIs engaged in less unhealthy exercise than other girls. In addition, the inclusion of BMI might also have clarified whether any of the participants were suffering from AN. Prior research has found that the lifetime prevalence of AN in adolescents is quite low (0.3%; Hoek, 2006). Therefore, it is unlikely that many girls in the symptomatic trajectory groups were currently or historically underweight. Third, girls were asked to report engagement in the behaviors over the two weeks preceding the assessment. This procedure is the standard one when using the EDE-Q in youth; our use of it facilitates comparison of the current results with those of other studies. Nonetheless, it may lead to underestimates of

engagement in the behaviors. Fourth, we did not measure compulsive exercise in addition to compensatory exercise, and the two predict other forms of disordered eating independently (Holland et al., 2014). Finally, fasting was measured dichotomously. We cannot know if different patterns of fasting behavior would have been apparent had it been measured on an interval scale.

The nonpurging compensatory behaviors of compensatory exercise and fasting appear to be present among early adolescent girls. There appear to be different groups of girls who proceed along different patterns of engagement in these behaviors during the middle school years. When present by themselves (i.e., without binge eating and purging behavior), both behaviors are associated with elevations in both depressive symptoms and the problematic expectancies for reinforcement from eating and from thinness. Research to further understand the development of these behaviors in youth can better inform clinical prevention and intervention efforts.

Acknowledgments

This research was supported by a grant from the National Institute on Alcohol Abuse and Alcoholism (NIAAA), RO¹ AA 016166 awarded to Gregory T. Smith.

References

- Allen KL, Crosby RD, Oddy WH, Byrne SM. Eating disorder symptom trajectories in adolescence: effects of time, participant sex, and early adolescent depressive symptoms. *Journal of Eating Disorders*. 2013; 1:1–14. [PubMed: 24764524]
- Bulik CM. Eating disorders in adolescents and young adults. *Child and Adolescent Psychiatric Clinics of North America*. 2002; 11(2):201–218. [PubMed: 12109318]
- Carter JC, Stewart DA, Fairburn CG. Eating disorder examination questionnaire: norms for young adolescent girls. *Behaviour Research and Therapy*. 2001; 39(5):625–632. [PubMed: 11341255]
- Coleman L, Coleman J. The measurement of puberty: a review. *Journal of Adolescence*. 2002; 25(5): 535–550. [PubMed: 12234559]
- Cooper Z, Fairburn C. The eating disorder examination: A semi-structured interview for the assessment of the specific psychopathology of eating disorders. *International Journal of Eating Disorders*. 1987; 6(1):1–8.
- Cooper MJ, Fairburn CG. Demographic and clinical correlates of selective information processing in patients with bulimia nervosa. *International Journal of Eating Disorders*. 1993; 13(1):109–116. [PubMed: 8477270]
- Culbert KM, Burt SA, McGue M, Iacono WG, Klump KL. Puberty and the genetic diathesis of disordered eating attitudes and behaviors. *Journal of Abnormal Psychology*. 2009; 118(4):788–796. [PubMed: 19899848]
- Crow S, Eisenberg ME, Story M, NeumarkDSztainer D. Suicidal behavior in adolescents: relationship to weight status, weight control behaviors, and body dissatisfaction. *International Journal of Eating Disorders*. 2008; 41(1):82–87. [PubMed: 17922538]
- Davis HA, Holland LA, Keel PK. A preliminary examination of a nonpurging compensatory eating disorder. *International Journal of Eating Disorders*. 2014; 47(3):239–243. [PubMed: 24105678]
- Davis, HA.; Riley, EN.; Smith, GT. Developmental Trajectories of Fasting Behavior and Driven Exercise Across the Middle School Years; Poster presented at the International Conference on Eating Disorders; San Francisco, CA. May. 2016
- Eddy KT, Doyle AC, Hoste RR, Herzog DB, Le Grange D. Eating disorder not otherwise specified in adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2008; 47(2): 156–164. [PubMed: 18176335]

- Fairburn CG, Beglin SJ. Assessment of eating disorders: Interview or self-report questionnaire. *International Journal of Eating Disorders*. 1994; 16(4):363–370. [PubMed: 7866415]
- Fairburn, CG.; Cooper, Z. The Eating Disorders Examination. In: Fairburn, CG.; Wilson, GT., editors. *Binge eating: Nature, assessment and treatment*. 12th. Guilford Press; New York: 1993.
- Fairburn, CG.; Cooper, Z.; O'Connor, M. Eating disorder examination. In: Fairburn, CG., editor. *Cognitive Behavior Therapy and Eating Disorders*. Guilford Press; 2008. Edition 16.0D
- Ferreiro F, Wichstrøm L, Seoane G, Senra C. Reciprocal associations between depressive symptoms and disordered eating among adolescent girls and boys: A multiwave, prospective study. *Journal of Abnormal Child Psychology*. 2014; 42(5):803–812. [PubMed: 24343793]
- Hoek HW. Incidence, prevalence and mortality of anorexia nervosa and other eating disorders. *Current Opinion in Psychiatry*. 2006; 19(4):389–394. [PubMed: 16721169]
- Hohlstein LA, Smith GT, Atlas JG. An application of expectancy theory to eating disorders: Development and validation of measures of eating and dieting expectancies. *Psychological Assessment*. 1998; 10(1):49–58.
- Holland LA, Brown TA, Keel PK. Defining features of unhealthy exercise associated with disordered eating and eating disorder diagnoses. *Psychology of Sport and Exercise*. 2014; 15:116–123.
- Godart NT, Perdereau F, Rein Z, Berthoz S, Wallier J, Jeammet P, Flament MF. Comorbidity studies of eating disorders and mood disorders. Critical review of the literature. *Journal of Affective Disorders*. 2007; 97(1):37–49. [PubMed: 16926052]
- Goldman MS, Brown SA, Christiansen BA, Smith GT. Alcoholism and memory: broadening the scope of alcohol-expectancy research. *Psychological Bulletin*. 1991; 110(10):137–146. [PubMed: 1891515]
- Little RJ, Rubin DB. The analysis of social science data with missing values. *Sociological Methods & Research*. 1989; 18(2-3):292–326.
- Luce KH, Crowther JH. The reliability of the eating disorder examination—Self-report questionnaire version (EDEDQ). *International Journal of Eating Disorders*. 1999; 25(3):349–351. [PubMed: 10192002]
- MacBrayer EK, Smith GT, McCarthy DM, Demos S, Simmons J. The role of family of origin food-related experiences in bulimic symptomatology. *International Journal of Eating Disorders*. 2001; 30(2):149–160. [PubMed: 11449448]
- Machado PP, Machado BC, Gonçalves S, Hoek HW. The prevalence of eating disorders not otherwise specified. *International Journal of Eating Disorders*. 2007; 40(3):212–217. [PubMed: 17173324]
- Miller WC, Anton HA, Townson AF. Measurement properties of the CESD scale among individuals with spinal cord injury. *Spinal Cord*. 2008; 46(4):287–292. [PubMed: 17909558]
- Mond JM, Calogero RM. Excessive exercise in eating disorder patients and in healthy women. *Australian and New Zealand Journal of Psychiatry*. 2009; 43(3):227–234. [PubMed: 19221911]
- Mond JM, Hay PJ, Rodgers B, Owen C. An update on the definition of “excessive exercise” in eating disorders research. *International Journal of Eating Disorders*. 2006; 39(2):147–153. [PubMed: 16231344]
- Mond JM, Hay PJ, Rodgers B, Owen C, Beumont PJV. Validity of the Eating Disorder Examination Questionnaire (EDE-Q) in screening for eating disorders in community samples. *Behaviour Research and Therapy*. 2004; 42(5):551–567. [PubMed: 15033501]
- Nagin, D. *Group-based modeling of development*. Harvard University Press; 2005.
- Neumark-Sztainer D, Wall MM, Story M, Perry CL. Correlates of unhealthy weight-control behaviors among adolescents: implications for prevention programs. *Health Psychology*. 2003; 22(1):88. [PubMed: 12558206]
- Neumark-Sztainer D, Story M, Falkner NH, Beuhring T, Resnick MD. Sociodemographic and personal characteristics of adolescents engaged in weight loss and weight/muscle gain behaviors: Who is doing what. *Preventive Medicine*. 1999; 28(1):40–50. [PubMed: 9973587]
- Pearson CM, Combs JL, Zapolski TC, Smith GT. A longitudinal transactional risk model for early eating disorder onset. *Journal of Abnormal Psychology*. 2012; 121(3):707–718. [PubMed: 22428790]

- Pearson CM, Zapolski TC, Smith GT. A longitudinal test of impulsivity and depression pathways to early binge eating onset. *International Journal of Eating Disorders*. 2015a; 48(2):230–237. [PubMed: 24659534]
- Pearson CM, Wonderlich SA, Smith GT. A risk and maintenance model for bulimia nervosa: From impulsive action to compulsive behavior. *Psychological Review*. 2015b; 122,:516–535. [PubMed: 25961467]
- Petersen AC, Crockett L, Richards M, Boxer A. A self-report measure of pubertal status: Reliability, validity, and initial norms. *Journal of Youth and Adolescence*. 1988; 17(2):117–133. [PubMed: 24277579]
- Pisetsky EM, May Chao Y, Dierker LC, May AM, Striegel-Moore RH. Disordered eating and substance use in high-school students: Results from the Youth Risk Behavior Surveillance System. *International Journal of Eating Disorders*. 2008; 41(5):464–470. [PubMed: 18348283]
- Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*. 1977; 1(3):385–401.
- Santos M, Richards CS, Bleckley MK. Comorbidity between depression and disordered eating in adolescents. *Eating Behaviors*. 2007; 8(4):440–449. [PubMed: 17950932]
- Simmons JR, Smith GT, Hill KK. Validation of Eating and Dieting Expectancy Measures in Two Adolescent Samples. *The International Journal of Eating Disorders*. 2002; 31:461–473. [PubMed: 11948651]
- Smith GT, Simmons JR, Flory K, Annus AM, Hill KK. Thinness and eating expectancies predict subsequent binge-eating and purging behavior among adolescent girls. *Journal of Abnormal Psychology*. 2007; 116(1):188–197. [PubMed: 17324029]
- Stiles-Shields EC, Bamford B, Lock J, Le Grange D. The effect of driven exercise on treatment outcomes for adolescents with anorexia and bulimia nervosa. *International Journal of Eating Disorders*. 2015; 48(4):392–396. [PubMed: 24729068]
- Stiles-Shields EC, Labuschagne Z, Goldschmidt AB, Doyle AC, Grange DL. The use of multiple methods of compensatory behaviors as an indicator of eating disorder severity in treatment-seeking youth. *International Journal of Eating Disorders*. 2012; 45(5):704–710. [PubMed: 22331840]
- Stiles-Shields EC, Goldschmidt AB, Boepple L, Glunz C, Le Grange D. Driven exercise among treatment-seeking youth with eating disorders. *Eating Behaviors*. 2011; 12(4):328–331. [PubMed: 22051370]
- Tobin DL, Griffing A, Griffing S. An examination of subtype criteria for bulimia nervosa. *International Journal of Eating Disorders*. 1997; 22(2):179–186. [PubMed: 9261657]
- Wade TD, O'Shea A. DSM-5 unspecified feeding and eating disorders in adolescents: What do they look like and are they clinically significant? *International Journal of Eating Disorders*. 2015; 48(4): 367–374. [PubMed: 24854848]

Figure 1.

Results of trajectory analyses on reported compensatory exercise behavior and fasting behavior, among girls, semiannually from 6th through 8th grades. The top panel presents trajectories of compensatory exercise behavior, and the bottom panel presents trajectories of fasting behavior. W1 – W6: wave 1 through wave 6. On the Y axis in the top panel, scores reflect the mean frequency of compensatory exercise behavior during the preceding two weeks: a score of 2 reflects engaging in compensatory exercise 3-4 times in the preceding two weeks. A score of 1 reflects engaging in the behavior 1-2 times in the preceding two weeks. On the Y axis in the bottom panel, the values reflect the proportion of people in that trajectory group who reported fasting behavior during the previous two weeks at that wave.

Table 1Descriptive Statistics: Compensatory Exercise and Fasting ($N= 564$)

Frequency (%) Endorsing Compensatory Exercise in Last 14 Days						
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
None	452 (80.1)	440 (78.0)	454 (80.5)	446 (79.1)	438 (77.7)	431 (76.4)
1-2 days	41 (7.3)	48 (8.5)	61 (10.8)	70 (12.4)	95 (16.8)	103 (18.3)
3-4 days	21 (3.7)	27 (4.8)	22 (3.9)	20 (3.5)	19 (3.4)	10 (1.8)
5-7 days	22 (3.9)	22 (3.9)	13 (2.3)	10 (1.8)	3 (0.5)	7 (1.2)
8-10 days	9 (1.6)	6 (1.1)	5 (0.9)	7 (1.2)	5 (0.9)	3 (0.5)
11-13 days	3 (0.5)	6 (1.1)	4 (0.7)	3 (0.5)	2 (0.4)	2 (0.4)
14 days	16 (2.8)	15 (2.7)	5 (0.9)	8 (1.1)	2 (0.4)	8 (1.1)
Number of Participants (%) Endorsing Fasting in Last 14 Days During Trajectory Period						
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
	39 (6.9)	35 (6.2)	29 (5.1)	28 (5.0)	29 (5.1)	22 (3.9)

Table 2

Descriptive Statistics: Study Variables in Elementary School

Study Variable and Wave	M	SD
Depression Symptoms (CES-D)- Wave 0	13.80	7.28
Eating Expectancies (EEI)- Wave 0	2.08	1.19
Thinness Expectancies (TREI)- Wave 0	2.95	1.59
Depression Symptoms (CES-D)- Wave 6	13.33	7.28
Eating Expectancies (EEI)- Wave 6	1.58	0.85
Thinness Expectancies (TREI)- Wave 6	2.10	1.33
Percent of girls who had experienced Pubertal Onset at Wave 0	22.5%	

Note: CES-D scores can range from 0 - 30. EEI and TREI scores are mean item scores, where 2 = not like me and 3 = somewhat like me. Wave 0 is the spring of 5th grade, six months prior to the onset of the trajectory period.

Table 3

Correlations among Study Variables at Wave 0 and Wave 6

	Compensatory Exercise Wave 0	Fasting Wave 0	Depression Wave 0	Eating Expectancies Wave 0	Thinness Expectancies Wave 0	Pubertal Status Wave 0	Compensatory Exercise Wave 6	Fasting Wave 6	Depression Wave 6	Eating Expectancies Wave 6	Thinness Expectancies Wave 6
Compensatory Exercise Wave 0		.37**	0.7	.05	.23**	.07	.01	.07	.02	-.01	.03
Fasting Wave 0			.15**	.07	.27**	.15**	.01	.11*	.03	.03	.04
Depression Wave 0				.26**	.11*	.06	.11*	.21**	.37**	.13**	.09
Eating Expectancies Wave 0					.17**	.03	.12*	.05	.07	.20**	.14**
Thinness Expectancies Wave 0						.05	.05	.03	.04	.08	.26**
Pubertal Status Wave 0							.12*	.09	.17**	.01	-.07
Compensatory Exercise Wave 0								.33**	.17**	.09	.17**
Fasting Wave 0									.10	.01	.14**
Depression Wave 0										.31**	.23**
Eating Expectancies Wave 0											.47**

N = 564;

* p

.01

*** p

.001

Table 4

Model-fit indices for trajectory analysis

Compensatory Exercise			
	Number of groups		
	2	3	4
AIC	-2752.38	-2672.86	-2579.35
BIC	-2795.27	-2752.51	-2733.76
aBIC [*]	-2782.73	-2729.21	-2699.71

Fasting		
	Number of groups	
	2	3
AIC	-634.43	-638.83
BIC	-674.25	-686.51
aBIC [*]	-662.60	-706.22

^{*} Sample size adjusted BIC

Table 5

Joint Trajectory Analysis Estimates of Membership in Trajectory Groups for the two Behaviors

	Non-Fasting	Fasting
Non-Compensatory Exercise	55.9%	0.8%
Decreasing Compensatory Exercise	25.0%	6.7%
Increasing Compensatory Exercise	3.2%	8.4%

Note: Joint trajectory analysis of compensatory exercise and fasting behavior provides an estimation of the percentage of girls who fall in each group, where a group reflects a combination of a compensatory exercise trajectory group and a fasting trajectory group.