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Do Maternal Psychosocial Factors Predict Adolescent Weight?

Sandra Jody Marks
Brigham Young University

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Master of Science

Lance E. Davidson, Chair
Bruce W. Bailey
Chad D. Jensen

Department of Exercise Sciences

Brigham Young University

ABSTRACT

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Sandra Jody Marks
Department of Exercise Sciences, BYU
Master of Science

Purpose: This study investigated the possible relationship between maternal psychosocial factors, mainly maternal stress and maternal depression, and adolescent weight status. Also, this study examined the predictive effect of these maternal psychosocial factors on adolescent weight loss during a health education intervention as well as the months following the health education.

Methods: Study design was a longitudinal pretest posttest with a health education intervention. We assessed 40 adolescents and their mothers on four occasions over a 1-year period. At each occasion, the Stress Index for Parents of Adolescents (SIPA) was used to measure maternal stress and the Beck Depression Inventory (BDI-II) was used to measure maternal depression. Also, at the four occasions, adolescent anthropometric data were obtained by research assistants using a digital scale for weight and a portable stadiometer for measuring height. Body Mass Index scores (BMI = [weight (kg)]/[height (m)]^2) were calculated and converted into a percentile score (zBMI), adjusting for age and gender, using the standard Center for Disease Control and Prevention calculator. At the onset of the study, the adolescent participants and their mothers all received 12 weeks of health education, which included group behavioral therapy, family-based intervention, motivational interviewing and electronic intervention.

Results: Hierarchical regression analysis revealed that no significant relationships existed between maternal stress and adolescent zBMI or between maternal depression and adolescent zBMI at baseline (Time 1). Nor did the study find that maternal stress and/or depression scores at Time 1 significantly predicted a greater amount of adolescent weight loss. Lower stress and/or depression also did not significantly predict adolescent weight maintenance after the 12-week intervention (Time 2). However, results did indicate that the adolescent component of the maternal stress domain (AD) from Time 1 to Time 2 was a significant predictor of adolescent zBMI from Time 1 to Time 2, ($\Delta R^2 = 0.238$, $F(1,21) = 6.571$, $p = 0.018$). This means that 23.8% of the variability in overall zBMI change from Time 1 to Time 2 is being accounted for by change in the maternal AD stress domain from Time 1 to Time 2.

Conclusion: Adolescent zBMI decreased concurrently with maternal stress during the health education intervention stage. Although the correlational nature of this study prevents causal claims, this result suggests that decreasing maternal stress may strengthen the ability of obese adolescents to effectively lose weight. This study encourages further research to examine the effects that maternal psychosocial factors may have on adolescent weight status, weight loss, and weight maintenance.

Keywords: maternal stress, maternal depression, adolescent weight, adolescent zBMI

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Introduction

The prevalence of overweight status among adolescents has tripled over the past 25 years.[1,2] Research shows adolescent overweight and obesity are linked to increased risk for disease and serious physical conditions.[3] These conditions include asthma, sleep disorders, cardiovascular diseases and type 2 diabetes.[4] Although genetically driven factors such as metabolism and height influence an adolescent's weight status,[5] parents play a significant role in creating the kind of health environment in which their children will reside throughout childhood and into adolescence.[6] Despite the fact that the level of parental control over an adolescent's food choices decreases for some children as they age into adolescence, studies show that their weight status can still be influenced by parenting characteristics and practices as children transition to adolescence.[7,8] Parental factors such as a parent's control of the availability of healthful foods and activities, parental modeling, parent socioeconomic factors, and maternal psychosocial health can determine an adolescent's healthy behaviors, and ultimately an adolescent's weight.[9]

Parents decide which types of foods are available for their adolescent to eat and what types of physical activities are readily available, all of which play a role in adolescent weight status.[10] The behavior parents model related to their own weight status, such as what, when, and how much they eat and exercise, also influences adolescents' weight-related behaviors.[11] A study conducted by Lee and Reicks found low-income adolescent girls who reported seeing their fathers consume milk had higher calcium intakes than girls who did not see their fathers drink milk.[12] Researchers who studied 141 adolescents in a focus-group discussion also found parental influence to be a central factor in their adolescents' eating behaviors.[13]

In addition to parent modeling of healthy behaviors, parent socioeconomic status (SES) can also serve as a potential environmental determinant of adolescent dietary behaviors. A

systematic review of 58 studies, which examined the potential household SES correlates of adolescent energy intake, concluded that both household income and parent education are inversely correlated with adolescent weight gain.[14]

Besides a parent's socioeconomic factors, a mother's level of psychosocial health can influence an adolescent's health environment.[15] Few efforts have been made to examine psychosocial factors such as maternal stress and depression, which may thwart parents' ability to inspire healthy weight habits for their children. Parents suffering from distress, for example, may not have the physical or emotional energy[16] to prepare healthy food options for their adolescent children. Stress is "a physical, chemical, or emotional factor that causes physical or mental strain."[17] Stress is a normal and inevitable part of life. The human body is equipped to handle stress; however, stress becomes negative when it continues without relief, resulting in distress.[18] Distress can lead to physical symptoms such as upset stomach, depression, increased blood pressure, metabolic dysfunction, physical fatigue, and headaches.[19] Any of these stress symptoms or combination of these symptoms may adversely affect a mother's ability to provide a positive health environment for her adolescent children, leading to adolescent overweight status.[15]

Besides stress, mothers suffering from the psychosocial factor of depression are at greater risk for implementing poor parenting practices.[20] A study by Lohman et al found that an increase in maternal stressors, such as depression, amplified a food-insecure adolescent's probability of being overweight.[21] The National Institute of Mental Health (NIMH) defines depression as a "common but serious mood disorder."[22] The NIMH explains that depression causes severe symptoms that negatively affect how one may think, feel, and handle daily activities. Since parenting is a daily task, depression has the potential to encumber a mother's role in both

modeling healthy practices and providing a healthy environment for her adolescent-aged children.

The current study is a subanalysis of recently-collected data from a yearlong project conducted by Dr. Jensen's laboratory.[23] The study included adolescents aged 13 to 18 years old and their mothers. Upon enrollment, adolescent participants were randomly assigned to 1) a 12-week standard behavioral weight control intervention with smartphone intervention for the first 12 weeks or 2) a 12-week standard behavioral weight control plus 24 weeks of smartphone intervention. The smartphone intervention included using an iPhone health tracking application (Daily Burn) to aid in daily behavioral therapy. Participants were assessed on four occasions over a 1-year period. Time 1 indicates measurements taken at baseline. Time 2 describes the assessment at the end of the first 12 weeks in which both groups received behavioral and smartphone intervention. Time 3 indicates the 24-week period after which one group received an additional 12 weeks for smartphone intervention while the other group was without additional intervention. Lastly, Time 4 indicates the 1-year period from baseline in which final measurements were taken. At each of the 4 occasions, in addition to obtaining adolescent anthropometric data, maternal stress and depression questionnaires were administered by research assistants. Since the commencement of Dr. Jensen's study in March of 2015, the adolescent BMI data have been analyzed and an evaluation of the smartphone-assisted behavioral weight control intervention has been conducted and is in process of being published.[23] Prior to the current study, the maternal psychosocial data that were collected had not yet been analyzed. This study examined the baseline relationship between maternal psychosocial factors, specifically maternal stress and maternal depression, and adolescent weight status within the context of Dr. Jensen's project. During and after the intervention, the adolescent's potential

success in losing and/or maintaining weight in the circumstances of the adolescent's environment, namely the parent's psychosocial health, was assessed as well.

The purpose of this study was to investigate a possible relationship between psychosocial factors, maternal stress and maternal depression, and adolescent weight status and/or weight change. The proposed mechanisms by which maternal psychosocial factors may affect adolescent eating behavior and weight status are depicted in Figure 1. This model is an adaptation of the model used by El-Behadli et al.[24] This model, like El-Behadli's model, combines sets of literature across multiple disciplines, including clinical psychology and nutrition and developmental psychology. The significant findings from this study are highlighted in the figure.

The relationship between maternal mental health and successful weight loss of adolescents was examined during a health education intervention (in-person group behavioral health education in addition to a smartphone intervention) as well as in the months following the health education. Previous studies have documented the association between maternal stress or depression and childhood overweight and obesity.[15,16] However, fewer studies have explored a similar association between maternal psychosocial factors and adolescent weight status. Findings from this study may help determine whether focusing on maternal stress and depression should be considered a potentially influential part of treatment programs for adolescent weight control.

We hypothesized that 1) there would be a positive association between maternal psychosocial factors (distress and/or depression) and adolescent weight status at baseline (Time 1), 2) lower maternal stress and/or depression scores at Time 1 would predict a greater amount of adolescent weight loss during a 12-week weight loss intervention, 3) health education intervention would concurrently decrease maternal stress, maternal depression, and adolescent

weight from Time 1 to the end of the 12-week intervention (Time 2), and 4) lower maternal stress and depression scores at Time 2 would predict improved adolescent weight maintenance at 12 months (Time 4).

Methods

Research Design

The intervention study was a longitudinal pretest posttest study design with a behavioral intervention (see Figure 2). Participants were assessed on 4 occasions over a 1-year period. At the onset of the study, the adolescent participants and their mothers both received 12 weeks of health education (Time 1 to Time 2). The health education consisted of important components of weight management including self-monitoring, portion control, problem solving, stimulus control, emotional eating, and physical activity. Upon enrollment, participants were randomly assigned to 1) standard behavioral weight control intervention or 2) standard behavioral weight control plus additional smartphone intervention. Participants in both groups received 12 weeks of health education and behavior modification intervention, with mothers and adolescents meeting in adjoining rooms for the intervention. For the first 12 weeks, both groups of participating adolescents received an iPhone with the health application to aid in the behavior therapy. Only the adolescents received the electronic intervention. Participants assigned to the enhanced intervention group kept the smartphone (iPhone 4) for an additional 12 weeks (Time 2 to Time 3).

The original contents of this study randomly separated the adolescent and their mothers into 2 groups from Time 2 to Time 3. Previous data analysis of BMI change by Jensen et al[25] found there was no significant difference between the two adolescent groups' BMI change scores from Time 2 to Time 3 when only 1 group maintained electronic intervention. For the purpose of

the current study, the participating adolescents were combined and analyzed as 1 group. The study focused on measurements taken at baseline (Time 1), the 12 weeks in which all participants received the same intervention (Time 1 to Time 2), and measurements taken at the 12-month follow-up (Time 4).

Recruitment

Adolescents were recruited from the community. Advertisements were posted in schools, pediatricians' offices, and community health centers. School nurses were also notified of the study and asked to refer potential participants. Those who responded to the advertisements phoned research assistants who provided study information and screened for study eligibility. If the interested party passed the phone screening, they were asked to schedule an in-person intake session with both the participating adolescent and the mother.

Subjects

The study sample is comprised of adolescents (ages 12 to18) and their mothers, recruited from the community (see Table 1 for participant's demographic information). The only inclusion criteria for the mother was she needed to be the parent most responsible for preparing meals at home. After being accepted into the study, the mothers were invited to report on maternal factors as well as measures of maternal stress by filling out the Stress Index for Parenting of Adolescents (SIPA) and Beck Depression Inventory (BDI-II) questionnaires. A total of 60 overweight (BMI percentile ≥ 85) or obese (BMI percentile ≥ 95) adolescents were enrolled. Inclusion criteria for the adolescents included: 1) parent/guardian and adolescent consent to participate; 2) the adolescent was age 13 to 18 years; 3) the adolescents exceeded the 85^{th} BMI percentile for age and sex; 4) the adolescent was living at home with a parent/guardian; 5) the adolescent did not have any serious mental illnesses (schizophrenia, bipolar disorder, autism, or any intellectual

disability) or developmental delays as listed in the exclusion criteria; and 6) the participants spoke English.

Procedures

Study procedures were approved by the Brigham Young University Institutional Review Board prior to the collection of any data. Participants provided informed consent/assent at an initial in-person meeting. Once consent was obtained, an initial assessment of adolescent and maternal height and weight was conducted by trained research assistants. Mothers were then invited to fill out an initial SIPA and BDI-II questionnaire. A description of these questionnaires is given below. Study assessments occurred on 4 occasions over a 1-year period including: (1) at baseline (Time1), (2) after completion of the 12-week intervention in which all adolescents received the same intervention (Time 2), (3) after completion of group 2 having the smartphone for an additional 12 weeks while group 1 had no additional intervention (Time 3), and (4) 1 year after the first treatment session (Time 4).

After the initial assessment, participants were given 12 weeks of weekly group intervention. The mothers were required to attend treatment sessions with their participating adolescent. Treatment was led by clinical psychology doctoral students under the supervision of a licensed psychologist. Mothers and adolescents attended separate group meetings lasting 75 minutes, with the last 10 minutes reserved for joint parent/adolescent discussion. Group sessions were standardized using a 12-week modular behavioral weight control program developed by Jensen et al.[26] The sessions consisted of important components of weight management including self-monitoring, portion control, problem solving, stimulus control, emotional eating, and physical activity. Each mother/adolescent pair also received 15 minutes of individual family intervention every 4 weeks after group sessions for a total of 3 sessions. Family intervention was

implemented with the idea that maternal support, family functioning, and the home environment are important motivational factors of treatment outcomes. Motivational interviewing was used to assess motivation and to problem solve how to overcome barriers to treatment during these family interventions. Motivational interviewing is a collaborative, person-centered form of guiding to induce and increase motivation for change.[27] During this study, motivational interviewing was used as a tool to help the adolescent and the mothers overcome their possible ambivalence toward change. The research team expressed empathy with the participants, listened carefully to the participants' concerns, and helped the participants make a plan to change their unhealthy behaviors.

Measurements

All questionnaires were completed in a research lab at the University Parkway Center at BYU. Questionnaires were administered prior to commencing treatment (Time 1), after the 12-week active treatment phase (Time 2), 6 months after the initial treatment session (Time 3), and 1 year after intake (Time 4). Measures obtained by questionnaires included a parent report of maternal stress from the SIPA and maternal depression from the BDI-II.

The SIPA is a screening and diagnostic instrument that identifies areas of stress in parent–adolescent interactions, allowing assessment of the relationship of parenting stress to adolescent characteristics (AD), parent characteristics (PD), the quality of the adolescent–parent interactions (APRD), and stressful life circumstances (LS). Areas of AD stress inspection include moodiness/emotional lability, social isolation/withdrawal, delinquency/antisocial, and failure to achieve or persevere. The PD domain of stress includes life restrictions, relationship with spouse/partner, social alienation, and incompetence/guilt. The APRD assesses the perceived

quality of the relationship that the parent has with the adolescent while the LS assesses other life stressors the parent may be experiencing not related to the adolescent.

The SIPA questionnaire consists of 112 statements. For the first 90 items, the mothers of adolescent participants self-report on a 5-point Likert Scale, from Strongly Disagree (1) to Strongly Agree (5). The remaining 22 items, comprising the LS Scale, are completed by circling "Yes" or "No" as to whether certain events have occurred in the past year. Parent responses automatically transfer to the scoring sheet. The SIPA profile form allows for interpretation of which statements describe which of the 4 domains of stress. Sheras and Abidin showed high test-retest reliability for the following domains: failure to achieve or persevere (0.90), parent domain (0.80), incompetence/guilt (0.83), and index of total parenting stress (0.97).[28] In 2012 the National Child Traumatic Stress Network (NCTSN) indicated that the SIPA test also met internal consistency requirements: failure to achieve or persevere (0.90), parent domain (0.94), incompetence/guilt (0.82), and index of total parenting stress (0.97).[28]

To measure maternal depression, the BDI-II questionnaire was administered to the mothers. It consists of a 21-question multiple-choice self-report inventory. The BDI-II questionnaire is "composed of items relating to symptoms of depression such as hopelessness and irritability, cognitions such as guilt or feelings of being punished, as well as physical symptoms such as fatigue and weight loss."[29] Englbrecht et al recently found that the BDI-II met the convergent validity criteria ($\rho > 0.50$) and was the only questionnaire to meet the predefined retest reliability criterion ($\rho \geq 0.70$; $r = 0.77$).[30] This group of researchers also concluded that the BDI-II was the most successful at achieving validity for both sensitivity and specificity (> 80%) when using the Montgomery–Asberg Depression Rating Scale (MADRS) as the gold standard.

Anthropometric data were obtained by research assistants using a digital scale (seca 869, measured to a tenth of a pound) for weight and a portable stadiometer (seca 216, measured to an eighth of an inch) for measuring height. Participants wore light clothing and no shoes for each assessment. Body Mass Index (BMI = [weight (kg)]/[height (m)]^2)[31] was calculated and converted into a percentile score, adjusting for age and gender, using the standard Center for Disease Control and Prevention calculator.[32] Anthropometric assessments were completed at the same 4 time periods as the questionnaire data.

Statistical Methods

Preliminary Analyses. Statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS). First, descriptive statistics were performed to check the assumptions of normality, linearity, homoscedasticity, and absence of multicollinearity. All other assumptions were met. A descriptive analysis was also used to test for outliers. SPSS uses a step of 1.5xIQR (Interquartile range) to identify outliers.[33] Three outliers with values between 1.5 and 3 times the interquartile range (IQR) were found. We chose to run the primary statistical analysis both with the original outlier value and with replacement values (as a result of fencing the outliers to the largest value within the 1.5 IQR). The fencing procedure did not significantly change the outcomes, hence the original values were used for analysis.

Primary Analyses. Hierarchical multiple regression analysis with SPSS was conducted to examine the 4 hypotheses presented in this study. Hierarchical regression is the process of adding or removing predictor variables from the regression model in steps. Specifically, stepwise hierarchical regression was chosen for our analysis. In this form of hierarchical regression, predictors are automatically added or removed from the regression model in steps based on the SPSS algorithms. Since our study included several predictors, this method determined

statistically which independent variable(s) have the most predictive power. Also, hierarchical regression showed if maternal depression and the 4 domains of maternal stress explained a statistically significant amount of variance in adolescent body mass index z-score (zBMI). The zBMI refers to the measure of relative weight adjusted for the adolescent's age and sex.

The first hypothesis in this study states maternal psychosocial factors have a predictive effect on adolescent weight status at baseline. To test this hypothesis, the stepwise hierarchal analysis used the 4 domains of maternal stress (adolescent domain (AD), parent domain (PD), adolescent-parent relationships domain (APRD), and life stressors (LS)) and maternal depression as the independent variables (IVs) while adolescent zBMI was used as the dependent variable (DV) (refer to Table 2).

Subsequently, the simultaneous effects of both maternal stress and depression were quantified to test the third hypothesis: maternal stress, maternal depression, and adolescent weight will decrease concurrently from Time 1 to Time 2. This analysis used the 4 maternal stress domain change scores and the maternal depression change score from baseline to Time 2 as the IVs. Adolescent zBMI change scores from baseline to Time 2 were used as the DV (refer to Table 2).

Stepwise hierarchical regression analyses were conducted to examine the predictive qualities of maternal stress and maternal depression on adolescent weight loss and maintenance during and after health intervention. For hypothesis 2, baseline maternal stress and depression measurements (IVs) were used to predict adolescent weight change (DV: adolescent zBMI change scores) during the 12-week intervention (refer to Table 2). Lastly, for hypothesis 4, Time 2 maternal stress and depression measurements (IVs) were used to predict weight maintenance

(DV: adolescent zBMI change scores from Time 2 to Time 4) during the 9-month post intervention (refer to Table 2).

Depending on which hypothesis is being tested, change scores were created by subtracting Time 2 scores from baseline or Time 4 scores from Time 2 scores. Where significant, main effects and interactions were reported.

Post Hoc Analysis. In an attempt to examine whether or not maternal stress is maintained concurrently with their adolescent's weight, a post hoc stepwise hierarchal analysis was conducted. For this post hoc analysis, the 4 maternal stress domain change scores and maternal depression change scores from Time 2 to Time 4 were used as the IVs. Adolescent zBMI change scores from Time 2 to Time 4 were used as the DV.

Results

Sixty-two adolescents and their mothers were enrolled in the study. Of these, 38 adolescents and their mothers completed the baseline study requirements (12 mothers did not fill out the SIPA and/or BDI questionnaire in its entirety). At Time 2 only 25 of the participating adolescents and their mothers showed up to the assessment. Due to dropouts, by the end of the study, only 16 adolescents and their mothers completed the follow up (Time 4) requirements. The appendix includes a complete outline of the variables and raw data at each assessment.

Association Between Maternal Psychosocial Factors and Adolescent Weight Status

Results from the regression analysis conducted using adolescent zBMI scores as the outcome variable revealed that no significant relationships existed between maternal stress and adolescent zBMI or between maternal depression and adolescent zBMI at baseline. Thus, the first hypothesis that there will be a positive association between maternal psychosocial factors (stress and/or depression) and adolescent weight status was not confirmed.

Maternal Psychosocial Factors as a Predictor of Adolescent Weight Loss

A hierarchical regression analysis was conducted to examine the second hypothesis that lower maternal stress and/or depression scores at baseline (Time 1) will predict a greater amount of adolescent weight loss during a 12-week weight loss intervention (from Time 1 to Time 2). This analysis revealed that neither maternal depression nor any of the maternal stress domains were significantly associated with adolescent weight loss.

Effects of Health Intervention on Maternal Stress, Maternal Depression, and Adolescent zBMI

A hierarchical regression analysis was conducted to examine the third hypothesis that maternal stress, maternal depression, and adolescent weight would decrease concurrently from baseline (Time 1) to the end of the 12-week intervention (Time 2). A change score for the maternal stress domains, maternal depression, and adolescent zBMI from Time 1 to Time 2 were used for this analysis. Results indicated that the AD of maternal stress from Time 1 to Time 2 was a significant predictor of adolescent zBMI change from baseline to Time 2 ($\Delta R^2 = 0.238$, $F(1,21) = 6.571$, $p = 0.018$) (See Table 3). The R-squared change score revealed that 23.8% of the variability in overall zBMI change from Time 1 to Time 2 is being accounted for by the change in the adolescent component (AD) of the maternal stress domain (see Table 3). The mean values for the study's variables with significant association can be found in Table 4.

The analysis also revealed a significant linear relationship ($p = 0.009$) between the AD and adolescent zBMI variables. This relationship shows that as the maternal AD stress is reduced, adolescent zBMI decreases, or as the maternal AD stress is increased, adolescent zBMI increases. Areas of AD stress domain include the mother's perceptions on her adolescent's moodiness/emotional liability, social isolation/withdrawal, delinquency/antisocial, and failure to achieve or persevere. The intervention may have improved the stress caused by the mother's

perception of her adolescent's characteristics while helping to lower the adolescent's zBMI at the same time. However, neither of the other maternal stress domains (LS, APBD, PD) nor maternal depression were significantly associated with the change in adolescent zBMI from Time 1 to Time 2.

Maternal Psychosocial Factors as a Predictor of Adolescent Weight Maintenance

Results from the hierarchical regression analysis conducted using adolescent zBMI scores as the outcome variable revealed that lower stress and/or depression did not significantly predict adolescent weight maintenance from Time 2 to Time 4. Hence, hypothesis 4 that suggested lower maternal stress and depression scores at Time 2 will predict improved adolescent weight maintenance at 12 months (Time 4) was not confirmed.

Maternal Stress and Adolescent Concurrent Weight Maintenance

The post hoc analysis showed a significant positive linear relationship between the change in AD stress and the change in adolescent zBMI (from Time 2 to Time 4) ($p = 0.037$). This implies that as maternal AD stress increased, the adolescent zBMI increased or that as stress decreased, the adolescent zBMI decreased.

Discussion

The purpose of this study was to investigate the possible predictive effect that maternal stress (4 different domains) and depression may have on adolescent weight status. This study hinges on previous research that has found associations between maternal psychosocial factors and adolescent obesity.[15] This yearlong study included 12 weeks of intervention for the participating adolescents and their mothers. The participants were assessed at baseline, after the intervention, and at a follow-up assessment at the 1-year mark. The primary findings of this study indicate that the change in the adolescent domain (AD) of maternal stress during the

intervention period is a significant predictor of the changes in adolescent zBMI during the intervention period. Due to the significant linear relationship between these 2 variables, the reverse statement may be true as well. The change in zBMI may predict a change in AD.

Examination of the predictive effect of the other maternal variables on adolescent zBMI did not have any significant findings. A post hoc analysis did find an additional significant linear relationship between the maintenance of AD stress and adolescent zBMI post intervention (see Table 2 for a complete construct of the variables examined).

Consistent with hypothesis 3, adolescent zBMI decreased concurrently with the adolescent domain of maternal stress during the health education intervention stage (see Table 4). Although the correlational nature of this study prevents causal claims, this result suggests that efforts to improve maternal stress may strengthen the ability of obese adolescents to effectively lose weight. The inverse may be true as well: efforts to improve adolescent weight status may also improve maternal stress. Studies that assess the concurrent improvement of maternal stress and adolescent obesity during an intervention are rare. The present study is the first to report on the change in maternal stress and adolescent weight during a behavior intervention period. A parallel study by Zeller et al[34] observed maternal stress (with SIPA data) and adolescent obesity post adolescent bariatric surgery. Contrary to this study's findings, while the weight of the adolescents decreased significantly with surgery in Zeller's study, the stress of the caregiver or mother did not significantly change in the year following surgery.[34] The differences in findings may be due to the type of health education the mothers received.

Supporting the findings in the present study, literature that reports high stress in the adolescent domain among mothers of adolescents with various health related issues is not new. A study by Wiener et al[35] found mothers of adolescents with ADHD reported more stress with

regard to their children's challenging behavior (AD domain on the SIPA test) than parents of adolescents without ADHD ($p < 0.001$; $r = 0.77$). The adolescent domain on the SIPA is measured by asking parents whether they agree with statements that describe challenging behaviors that occur in adolescence. These include issues with school performance, emotion regulation, peer relations, and risky behaviors. Maternal stress in this domain suggest that it is a mother's perception and experience of her teen's oppositional behavior that contribute to her stress. The decrease in AD stress in this study may be linked to stress that mothers have experienced for a period of time that was unchecked. The success of the weight loss intervention for their adolescents may have helped relieve adolescent-induced stress for the mothers as an added benefit. This finding suggests that improving the weight of the adolescent can in turn improve the mental health of the mother in addition to the previous suggestion that improving the mental health of the mother may improve the weight status of the adolescent.

Examining the depression index scores of the mothers during the intervention period, we find that although the linear relationship between depression and zBMI is not significant as deemed in this study, the relationship ($p = 0.097$) does approach significance and gives argument for further research. The Beck depression threshold used in this study does not measure a parent's interaction with their adolescent which may be why the relationship was not stronger. Future studies may benefit from using a depression index that measures maternal depression in connection to their child's behavior.

Although the intervention used in this study was designed as a weight loss tool for the adolescent, the findings from this study show that the stress level of the mothers was also reduced. To deduce possible explanations of why the present study was successful in improving maternal stress and adolescent zBMI concurrently, we can examine the types of interventions

used. The literature suggest that a family-based intervention, as used in the present study, results in concurrent benefits for mothers and adolescents.[36,37] Adding support to the adolescent improvements in the present study, researchers found family-based treatment was more effective in promoting adolescent behavior changes than adolescent-focused individual therapy.[38] Family interventions are implemented with the idea that parental support, family functioning, and the home environment are important motivational factors of treatment outcomes.[39] The intentions of family-based intervention may be a factor in this study's significant outcomes.

Along with family-based intervention, motivational interviewing was utilized in this study and may have contributed to the concurrent improvements in the adolescent domain of maternal stress and adolescent zBMI. Physical health specialties have begun utilizing motivational interviewing in families with children at differing ages and developmental stages more regularly.[40] Motivational interviewing is a collaborative, person-centered form of guiding to induce and increase motivation for change.[27] Researchers have found that participants lose more weight, have increased physical activity, and improve dietary intake when motivational interviewing is added to the behavioral weight loss programs relative to when only a behavioral weight loss program is administered.[41]

From this study's findings, we can also suggest that group health education intervention may have been a useful tool in decreasing maternal stress for mothers with obese adolescents and/or aiding adolescents in losing weight. As shown in the literature, group behavior intervention can be as successful as individual treatment in helping individuals make positive behavior changes.[42] Group intervention is unique because of its propensity to provide social support, empathy, and healthy competition.

As supported in the research, family-based therapy, group therapy, and motivational interviewing may have influenced the concurrent improvements in both maternal stress and adolescent weight found in this study. Since previous analyses by Jensen and his team[25] showed there was no significant difference between the original 2 groups in the second 12 weeks of the study (when one group got an iPhone and one received no intervention), it was inferred that the electronic intervention was not an influential component of the behavior intervention. Family and group therapy, on the other hand, add the support of parents and other persons while motivational interviewing adds guidance to induce and increase motivation for change.

The significant finding that the AD domain of maternal stress and adolescent zBMI change concurrently also suggest there may be an influential relationship between the mother and her adolescent. The significant linear relationship ($p = 0.009$) between these 2 variables shows that maternal AD stress increases along with adolescent zBMI. The opposite is also true: as the maternal AD stress is reduced, adolescent zBMI decreases. Unfortunately, the analysis is unable to show the directionality of the relationship between maternal stress and adolescent zBMI. For instance, we cannot state whether the decreased stress levels of the mother encouraged the adolescent to lose weight or whether it was the lowered adolescent's zBMI that influenced the mother to lower her stress level. The AD domain of stress indicates the extent to which a mother's stress is caused by her concern for her adolescent. Since this study showed that the adolescent domain of these mothers' stress was the only stress domain that significantly changed concurrently with their adolescent's zBMI, the results suggest that the concerns a mother has for her adolescent may be her leading source of stress.

This present study did not find maternal psychosocial factors (stress and/or depression) to be a predictor of adolescent weight status at baseline. This is similar to the findings by Guilfoyle

et al. Their cross sectional analysis found that although 18% of participating caregivers had elevated levels of parenting stress, parenting stress did not significantly predict adolescent BMI at treatment initiation.[2] Contrastingly, in a study conducted by Parks et al, hierarchical stepwise regression demonstrated significant positive relationships between maternal stress and obese adolescents. Parks et al found that maternal stress was a significant predictor of adolescent's poor health-related behaviors such as avoiding fruits and vegetables. The limited variability in the baseline sample (a homogeneous population of overweight/obese children and concerned mothers) may explain why the analysis did not find the relationship we hypothesized, but that are found in several other cross-sectional studies in the literature.

Furthermore, the present study failed to support the hypothesis that maternal stress and/or depression scores at baseline may significantly predict a greater amount of adolescent weight loss. The use of self-report for stress and depression data may have led to an underestimation of maternal stress and depression. For any number of reasons, the adolescents' mothers may have been unwilling to share their possibly higher stress and depression levels. The low number of subjects may have also contributed to nonsignificant findings between the relationship of maternal psychosocial factors and adolescent weight status or weight loss. Also, it is possible that an adolescent's nonobservance to the intervention strategies may have limited successful weight loss outcomes.

The present study did not discover that lower maternal stress and depression scores at Time 2 significantly predicted improved adolescent weight maintenance at 12 months (Time 4). Although the statistic is not significant, we noticed (see Appendix for raw data) for a portion of the mother-adolescent pairs, lower maternal depression scores were present with adolescent weight maintenance after the health intervention stage. The results may have been stronger if not

for the large number of dropouts the study experienced. The self-reported data may have limited this correlation as well. As with hypotheses 1 and 2, loose adherence to the health education concepts may have also influenced the nonsignificant outcomes. Since the adolescents were on their own during the second half of the study, compliance to health strategy was unmeasured. In the future, studies may suggest having the participants use a journal or a log to track their compliance.

In an attempt to examine whether or not maternal stress is maintained concurrently with adolescent weight, a post hoc stepwise hierarchal analyses was conducted. As expected, the analysis showed a significant positive linear relationship between the change in zBMI (from Time 2 to Time 4) and the change in the maternal AD domain of stress (from Time 2 to Time 4) ($p = 0.037$). This implies that as maternal AD stress increased, the adolescent zBMI increased or that as stress decreased, the adolescent zBMI decreased. From the analysis, we can presume that maternal stress may influence how well adolescents maintain their weight or, on the other hand, adolescent weight maintenance may be influencing maternal stress. This finding supports studies such as Lohman et al[21] that have reported maternal stressors are significantly linked to the probability of adolescents being overweight. However, the analysis did not show that the AD domain of stress was a uniquely significant contributor to the prediction model. The limitations of the self-reported questionnaire data, dropouts, and possible noncompliance may have hindered more significant findings in the post hoc analyses.

The results of this study may provide some insight into the potential mechanisms of the relationship between maternal stress and adolescent zBMI; decreasing maternal stress caused by concern about her adolescent appears to be more influential in aiding adolescent weight loss than decreasing other life stressors. The inverse may be equally as paramount: decreasing adolescent

weight may be an influential tool to decrease adolescent-induced stress for mothers. This finding emphasizes the importance of the mother psychosocial factor-adolescent weight status relationship. The interventions used in this study focused on giving the adolescents responsibility over their health choices while stressing the importance of support from the mother. This approach may have helped relieve some of the adolescent-induced stress mothers perceived as having while at the same time encouraging the adolescents to take control of their own health. While encouraging mothers to provide an optimal health environment and modeling of healthy food and activities, encouraging the adolescent to make responsible health choices when away from home was stressed in the health behavior intervention. Improved efforts to decrease maternal stress, particularly within the AD of stress, may aid adolescents in decreasing their zBMI. Conversely, decreasing zBMI may also improve the overall health of the adolescent as well as the mental health of the mother.

One strength of this study was the longitudinal design that allowed us to collect measureable change over an entire year, including a postintervention follow-up period. The uniqueness of being able to study a group of individuals over time allowed us to see patterns of the variables over time. Another strength of this study is the novelty of this study. Few studies have examined the impact of maternal mental health on adolescent weight status.

Notable weaknesses were also present which inspire further research on this topic. First, one of the greatest limitations of this study was the number of dropouts. Due to the yearlong longitudinal design of the study, dropouts were inevitable. Out of the 38 baseline participants and their mothers, only 16 reported to the final 12-month follow-up visit. The modest sample size was also a limitation in this study. In future studies, a larger sample size would add power to this type of study and help offset the rate of attrition. The time and effort required to collect data

could be considered strenuous and may have been a contributing factor to attrition, thus making the results of completers less representative of the original sample, and perhaps not as generalizable. Improved methods to decrease attrition in future studies would be helpful. For example, Fumagalli et al[43] found that despite being one of the cheapest methods among those analyzed, mailing a change-of-address card with an incentive conditional on return if a move occurs was the most effective method to decrease attrition. According to Brueton et al,[44] other strategies to decrease attrition that may be helpful in future studies include variety of communication methods, shorter questionnaire length, variety of incentives, and improved researcher/client relationship.

Lastly, the subjective nature of the SIPA and BDI-II questionnaires can be a limitation. Participants may not be willing to divulge their true level of mental health problems to researchers. Since this was a longitudinal study and the same subjective tests were administered multiple times, the effect of this type of error would accumulate.

Future studies that include maternal psychosocial measurements and overweight or obese adolescents would be helpful in discovering the possible influence a mother's mental health has on her adolescent's weight status and weight change. Adding a control group that does not receive any intervention would be helpful in recognizing the success of health interventions in improving both maternal mental health and adolescent weight status.

Conclusion

The results of this study demonstrate that changes in maternal stress may be a predictor of improvements in adolescent zBMI during a behavior health intervention. In addition, the post hoc results show improvements in maternal stress may be correlated with adolescent weight maintenance following a health intervention stage. There are comparatively few studies that

examine the impact of maternal mental health on adolescent weight status. This novel study is important in bringing to light the possible connection between maternal psychosocial factors and adolescent obesity. By focusing on both aspects of the mother psychosocial factor-adolescent weight status relationship, benefits to maternal mental health and adolescent weight status may be improved. Future research evaluating the effects of mental health on adolescent weight status before, during, and following a behavior health intervention will provide a more thorough understanding on the predictive effects that maternal psychosocial factors may have on adolescent weight status. Continued research efforts in this area will likely be influential in the fight against adolescent obesity and may help professionals create effective prevention and intervention programs for adolescent health.

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Table 1. Baseline Participant Characteristics

	n	Mean (SD)	Range
Adolescents			
Females	26		
Males	12		
Age	38	14.7 (1.4)	12.7 – 16.8
BMI percentile	38	97.7 (1.6)	94.0 – 99.8
zBMI	38	2.1 (0.4)	1.5 – 2.9
Mothers			
Age	38	43.8 (5.0)	32.7 – 55.5
Depression			
BDI-II	38	12.2 (10.3)	0.0 – 41.0
Stress			
AD	38	99.9 (27.0)	50.0 – 143.0
PD	38	82.7 (24.0)	36.0 – 143.0
APRD	38	31.9 (8.5)	16.0 – 53.0
LS	38	3.7 (2.8)	0.0 – 13.0

n = number of participants, SD = standard deviation

Description of depression and stress abbreviations: Beck Depression Inventory score (BDI-II), adolescent characteristics (AD), parent characteristics (PD), the quality of the adolescent–parent interactions (APRD), and stressful life circumstances (LS).

Body Max Index percentile (BMI percentile) overweight range is $\geq 85^{th}$ percentile and the obese range is $\geq 95^{th}$ percentile. BMI z-score (zBMI) > 1 is considered overweight and a zBMI > 2 is in the obese range.

Table 2. Hypothesis Constructs

Hypothesis	Dependent Variables	Independent Variables
Hypothesis 1	Adolescent BMI z-score at baseline	Maternal Depression At baseline (BDI test) Maternal Stress Domains (LS,APRD,PD,AD) At baseline (SIPA test)
Hypothesis 2	Adolescent BMI z-score change from baseline to Time 2	Maternal Depression At baseline (BDI test) Maternal Stress Domains (LS,APRD,PD,AD) At baseline (SIPA test)
Hypothesis 3	Adolescent BMI z-score change from baseline to Time 2	Maternal Depression Change score From baseline to TIME 2 Maternal Stress Domains (LS,APRD,PD, AD^{++} **) Change score from baseline to TIME 2
Hypothesis 4	Adolescent BMI z-score change from Time 2 to Time 4	Maternal Depression At Time 2 Maternal Stress Domains (LS,APRD,PD,AD) At Time 2
Post hoc	Adolescent BMI z-score change from TIME 2 to TIME 4	Maternal Depression Change score From Time 2 to Time 4 Maternal Stress Domains (LS,APRD,PD, AD^{++}) Change score from Time 2 to Time 4

++ denotes a significant linear relationship between the IV and the DV ($p < .05$)
** represents a significant IV predictor of the DV ($p < .05$)

Table 3. Means, Standard Deviations, and Ranges used in Analyses for Hypotheses 1 and 2

	Time	n	Mean (SD)	Range
Hypothesis 1				
Adolescent zBMI	T1	38	2.1 (0.4)	1.5–2.9
Maternal Depression	T1	38	12.2 (10.3)	0.0–41.0
Maternal Stress (AD)	T1	38	99.9 (27.0)	50.0–143.0
Maternal Stress (PD)	T1	38	82.7 (24.0)	36.0–143.0
Maternal Stress (APRD)	T1	38	31.9 (8.5)	16.0–53.0
Maternal Stress (LS)	T1	38	3.7 (2.8)	0.0–13.0
Hypothesis 2				
Adolescent zBMI	T1	25	2.2 (0.4)	1.5–2.9
	T2	25	2.1 (0.5)	1.1–2.8
	T2-T1	25	-0.16 (0.1)	-0.5–0.1
Maternal Depression	T1	25	9.5 (8.7)	0.0–28.0
Maternal Stress (AD)	T1	25	102.8 (27.5)	51.0–143.0
Maternal Stress (PD)	T1	25	78.1 (21.7)	36.0–143.0
Maternal Stress (APRD)	T1	25	32.7 (8.5)	16.0–53.0
Maternal Stress (LS)	T1	25	3.0 (2.8)	0.0–13.0

Hypothesis 1 stated there would be an association between maternal psychosocial factors (distress and/or depression) and adolescent weight status at baseline; Hypothesis 2 stated lower maternal stress and/or depression scores at Time 1 will predict a greater amount of adolescent weight loss during a 12-week weight loss intervention; n = number of participants with complete data for each analysis; SD = standard deviation; zBMI = BMI z-score; AD = adolescent characteristics; PD = parent characteristics; APRD = the quality of the adolescent–parent interactions; LS = stressful life circumstances; T2-T1 = change score from Time 1 to Time 2.

Table 4. Means, Standard Deviations, and Ranges used in Analyses for Hypothesis 3

	Time	n	Mean (SD)	Range
Hypothesis 3				
Adolescent zBMI	T2-T1	25	-0.1 (0.1)	-0.5–0.1
Maternal Depression	T1	24	9.6 (8.7)	0.0–28.0
	T2	24	8.0 (7.9)	0.0–26.0
	T2-T1	25	-1.6 (4.9)	-11.0–11.0
Maternal Stress (AD)	T1	25	102.8 (27.5)	51.0–143.0
	T2	25	99.8 (25.4)	58.0–45.0
	T2-T1	25	-3.1 (16.4)	-38.0–37.0
Maternal Stress (PD)	T1	25	78.1 (21.7)	36.0–143.0
	T2	25	72.2 (19.5)	37.0–112.0
	T2-T1	25	-5.8 (12.2)	-31.0–27.0
Maternal Stress (APRD)	T1	25	32.7 (8.5)	0.0–13.0
	T2	25	31.8 (8.0)	19.0–53.0
	T2-T1	25	-0.9 (5.2)	-14.0–7.0
Maternal Stress (LS)	T1	25	3.0 (2.8)	0.0–13.0
	T2	25	2.7 (2.8)	0–11.0
	T2-T1	25	-0.3 (2.4)	-9.0–14.0

Hypothesis 3 stated health education intervention will concurrently decrease maternal stress, maternal depression, and adolescent weight from Time 1 to the end of the 12-week intervention (Time 2); n = number of participants with complete data for each analysis; SD = standard deviation; zBMI = BMI z-score; AD = adolescent characteristics; PD = parent characteristics; APRD = the quality of the adolescent–parent interactions; LS = stressful life circumstances; T2-T1 = change score from Time 1 to Time 2.

Table 5. Means, Standard Deviations, and Ranges Used for Hypothesis 4 and Post Hoc Analyses

	Time	n	Mean (SD)	Range
Hypothesis 4/ Post hoc				
Adolescent zBMI	T2	16	2.0 (0.5)	1.1–1.7
	T4	16	2.0 (0.5)	1.1–2.8
	T4-T2	16	0.0 (0.1)	-0.4–0.2
Maternal Depression	T2	16	5.7 (6.8)	0.0–26.0
	T4	16	7.0 (8.5)	0.0–32.0
	T4-T2	16	1.8 (3.8)	-5.0–9.0
Maternal Stress (AD)	T2	16	101.6 (26.6)	58.0–145.0
	T4	16	91.1 (22.1)	56.0–134.0
	T4-T2	16	-10.5 (14.6)	-42.0–6.0
Maternal Stress (PD)	T2	16	71.6 (18.3)	37.0–107.0
	T4	16	70.3 (21.2)	34.0–116.0
	T4-T2	16	-1.3 (8.1)	-19.0–10.0
Maternal Stress (APRD)	T2	16	34.1 (8.9)	19.0–53.0
	T4	16	33.7 (8.7)	16.0–52.0
	T4-T2	16	-0.3 (7.7)	-14.0–20.0
Maternal Stress (LS)	T2	16	2.4 (1.8)	0.0–7.0
	T4	16	1.9 (2.0)	0.0–7.0
	T4-T2	16	-0.5 (1.0)	-2.0–1.0

Hypothesis 4 stated lower maternal stress and depression scores at Time 2 will predict improved adolescent weight maintenance at 12 months (Time 4); Post hoc analysis examined whether or not maternal stress is maintained concurrently with their adolescent's weight after the intervention period; n = number of participants with complete data for each analysis; SD = standard deviation; zBMI = BMI z-score; AD = adolescent characteristics; PD = parent characteristics; APRD = the quality of the adolescent–parent interactions; LS = stressful life circumstances; T4-T2 = change score from Time 2 to Time 4.

Table 6. Model Summary of Hypothesis 3 Significant Variables

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	Sig. F Change
1	.488	.238	.202	.10968	.238	6.571	1	21	.018

Dependent Variable: adolescent zBMI change score (Time 2 minus Time 1)
Predictor: Maternal stress adolescent domain (AD) change score (Time 2 minus Time 1)

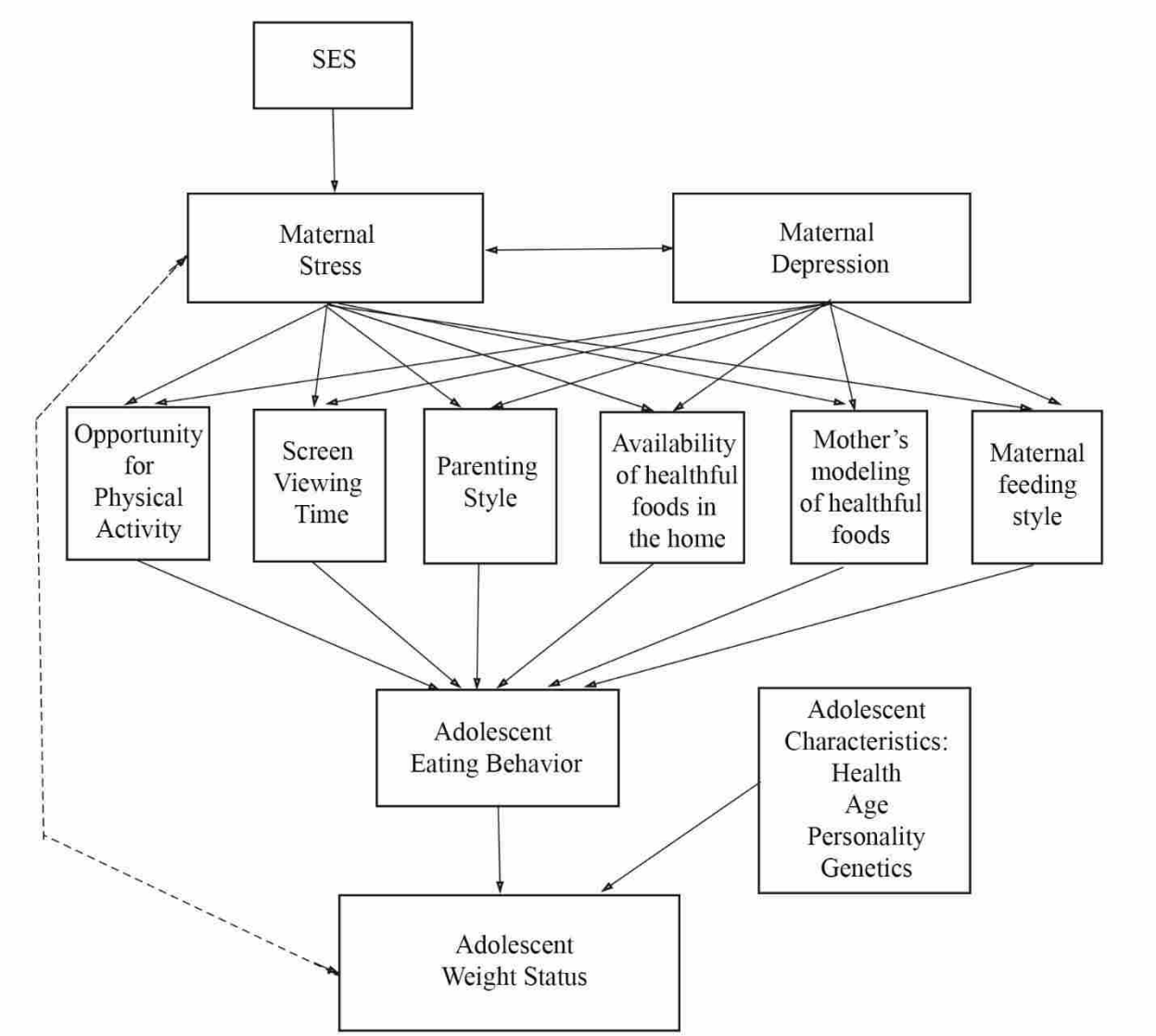

Figure 1. Framework for Theory that Maternal Psychosocial Factors Influence Adolescent Weight Status

Dashed line represents the significant findings from this study. Solid line with arrows represent the proposed mechanisms by which maternal psychosocial factors may affect adolescent eating behavior and weight status as found in the literature. Lines with double arrows indicate a possible bidirectional influence.

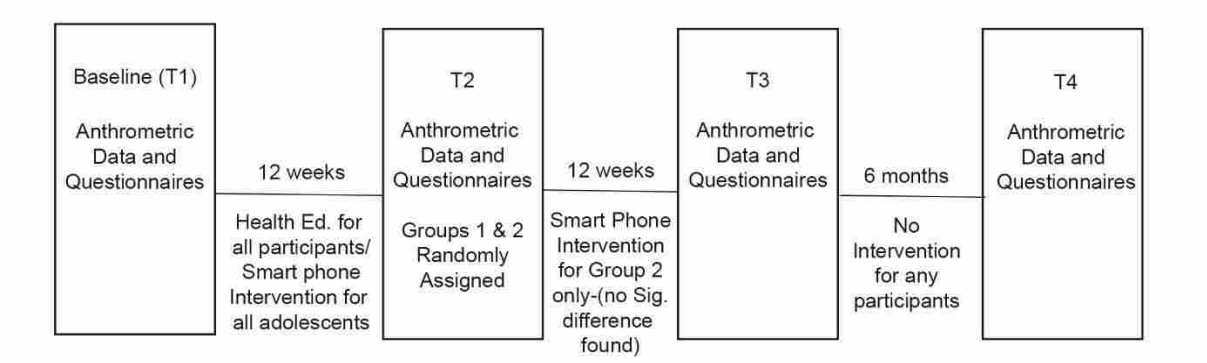

Figure 2. Longitudinal Pretest Posttest Design Model

Appendix

Raw Data Time 1 Variables (n = 38)

ID #	T1-AD	T1-PD	T1-APRD	T1-LS	T1- BDI	T1- zBMI
18	51	36	19	3	7	1.54
19	85	76	29	2	6	1.96
20	108	102	30	4	24	2.69
22	80	69	33	1	4	1.83
24	124	105	51	4	20	1.95
25	143	86	53	3	22	2.01
26	123	72	34	3	8	2.56
27	54	76	21	9	16	2.84
30	104	73	32	0	0	1.64
31	104	86	20	4	8	2.19
32	84	72	16	8	16	2.86
33	116	73	37	4	2	2.55
34	111	59	28	1	1	1.56
35	133	91	30	13	28	1.7
36	129	81	30	8	10	2.23
38	140	96	44	3	10	2.03
40	113	104	33	4	15	1.6
41	80	113	31	1	18	2.29
42	50	47	16	2	8	1.61
43	93	104	31	7	41	1.72
44	108	113	32	7	21	1.92
45	118	140	34	4	31	1.98
46	131	120	43	3	15	2.34
47	76	64	28	6	3	2.44
48	104	65	34	3	1	2.67
49	78	116	29	6	5	1.88
50	111	62	33	2	2	1.96
51	100	67	33	1	1	2.04
52	68	62	29	5	14	2.19
53	109	87	37	5	30	2.21
54	59	65	24	3	5	2.31
55	74	61	27	1	8	1.58
56	81	76	32	0	16	2.43
57	120	73	32	1	8	2.03
58	141	69	48	4	4	2.84
59	84	70	28	0	0	2.68
60	142	143	44	2	28	1.98
61	68	70	25	2	5	2.09

Raw Data Time 2 Variables (n = 25)

ID #	T2-AD	T2-PD	T2-LS	T2-APRD	T2- BDI	T2- zBMI
18	68	37	4	19	3	1.63
19	82	63	3	26	5	1.97
20	145	95	9	37	23	2.76
22	95	73	1	30	8	1.68
24						
25	145	80	3	49	11	2.07
26	101	67	3	40	8	2.62
27						
30	115	77	0	34	1	1.6
31						
32	67	74	11	23	12	2.75
33	115	72	3	38	1	2.57
34	84	47	2	27	3	1.11
35	95	65	4	27	19	1.5
36						
38	139	94	2	36	12	1.92
40	105	107	7	35	26	1.5
41						
42						
43						
44						
45						
46	120	101	2	35	5	2.16
47	76	60	4	27	3	2.48
48	120	59	2	36	1	2.65
49						
50						
51	107	71	0	32	0	1.92
52						
53						
54	58	60	2	23	1	2.28
55	77	53	0	26	8	1.48
56	90	68	0	31	8	2.52
57	101	45	1	28		1.88
58	128	96	2	53	3	2.82
59	73	56	0	20	1	2.67
60	120	112	1	30	25	1.88
61	68	74	1	32	4	1.89

Raw Data Time 4 Variables (n = 16)

ID #	T4-AD	T4-APRD	T4-LS	T4-PD	T4-BDI	T4 zBMI
18	63	16	4	34	5	1.52
19						
20						
22	83	26	0	77	3	1.65
24						
25	103	44	3	61	20	1.97
26	88	35	2	73	7	2.77
27						
30	103	36	0	80	1	1.65
31						
32						
33	120	37	3	70	3	2.67
34	82	22	2	54	3	1.11
35						
36						
38	106	37	0	90	11	1.56
40	111	37	7	116	32	1.57
41						
42						
43						
44						
45						
46						
47	68	30	2	57	5	2.48
48	90	30	0	58	0	2.65
49						
50	114	31	2	44	0	2.13
51	91	33	1	69	0	1.75
52						
53						
54	56	32	1	42	3	2.22
55						
56						
57						
58	134	39	3	98	12	2.79
59						
60						
61	68	52	0	75	7	1.79

Raw Data Change Scores (Time 2 minus Time 1) Variables (n = 25)

ID #	T2-T1 zBMI	T2BDI-T1BDI	T2PD-T1PD	T2AD-T1AD	T2APRD-T1APRD	T2LS-T1LS
18	0.09	-4	1	16	0	1
19	0.01	-1	-13	-3	-3	1
20	0.07	-1	-7	37	7	5
22	-0.15	4	4	15	-3	0
24						
25	0.06	-11	-6	2	-4	0
26	0.06	0	-5	-22	6	0
27						
30	-0.04	1	4	11	2	0
31						
32	-0.11	-4	2	-16	6	3
33	0.02	-1	-1	-1	1	-1
34	-0.45	2	-12	-27	-1	1
35	-0.2	-9	-26	-38	-3	-9
36						
38	-0.11	2	-2	-1	-8	-1
40	-0.1	11	3	-8	2	3
41						
42						
43						
44						
45						
46	-0.18	-10	-19	-11	-8	-1
47	0.04	0	-4	0	-1	-2
48	-0.02	0	-6	16	2	-1
49						
50						
51	-0.12	-1	4	7	-1	-1
52						
53						
54	-0.03	-4	-5	-1	-1	-1
55	-0.1	0	-8	3	-1	-1
56	0.09	-9	-8	9	-1	0
57	-0.15		-28	-19	-4	0
58	-0.02	-1	27	-13	5	-2
59	-0.01	1	-14	-11	-8	0
60	-0.1	-3	-31	-22	-14	-1
61	-0.2	-1	4	0	7	-1

Raw Data Change Scores (Time 4 minus Time 2) Variables (n = 16)

ID #	T4-T2 zBMI	T4-T2 BDI	T4-T2PD	T4-T2AD	T4APRD-T2APRD	T4LS-T2LS
18	-0.11	2	-3	-5	-3	0
19						
20						
22	-0.03	-5	4	-12	-4	-1
24						
25	-0.1	9	-19	-42	-5	0
26	0.15	-1	6	-13	-5	-1
27						
30	0.05	0	3	-12	2	0
31						
32						
33	0.1	2	-2	5	-1	0
34	0	0	7	-2	-5	0
35						
36						
38	-0.36	-1	-4	-33	1	-2
40	0.07	6	10	6	2	0
41						
42						
43						
44						
45						
46						
47	0	2	-3	-8	3	-2
48	0	-1	-1	-30	-6	-2
49						
50	2.13	0	44	114	31	2
51	-0.16	0	-2	-16	1	1
52						
53						
54	-0.06	2	-18	-2	9	-1
55						
56						
57						
58	-0.03	9	2	6	-14	1
59						
60						
61	-0.1	3	1	0	20	-1