**Teen Sleep 6-month Follow-up Paper**

To-Dos:

1. Improve on the methods section (paraphrase)
2. Work on data analysis section
3. 3-way interaction report: creating a table that lists p-value adjustment
4. Improve results section: description of post to follow-up changes
5. Introduction outline draft
6. Discussion points

Grant abstract:

Teens who exhibit a circadian tendency toward eveningness (‘night-owls’) follow a delayed sleep schedule, increasing activity later in the day and both going to sleep and getting up later, compared to morning-types (‘larks’). The circadian tendency toward eveningness during adolescence arises from a confluence of psychosocial, behavioral and biological factors and is an important contributor to, and maybe even cause of, vicious cycles that escalate vulnerability and risk for poor health and major forms of psychopathology. Indeed, an evening circadian tendency has been associated with a wide range of adverse effects including poorer health, poorer academic performance, poorer self-regulation, greater use of substances, greater tendency for impulsivity, more depression and anxiety, greater emotional instability and more aggressive and antisocial behavior. While the biological shift toward eveningness during puberty may be difficult to modify, the psychosocial and behavioral contributors are modifiable. Moreover, modifying these contributors will eliminate key factors that exacerbate the biological shift. The proposed research will advance current knowledge on the role of eveningness as a mechanism contributing to poorer outcomes during adolescence. We aim to reduce eveningness among 10-18 year olds via an innovative intervention; the BRIGHT intervention (Biological Rhythm Intervention for Growing Healthy Teens) which integrates evidence-based treatments derived from basic research on the circadian system. We will randomly allocate adolescents with an evening circadian tendency, and who are ‘at risk’ in at least one of five health domains (emotional, cognitive, behavioral, social, physical), to either: (a) BRIGHT (n = 86) or (b) Psychoeducation (n = 86). Measures will be taken pre-treatment, post-treatment, and at 6 and 12 months post-treatment. The hypothesis to be tested is that BRIGHT, relative to Psychoeducation, will be associated with improvement in sleep and the five health-relevant domains at the end of treatment and that these gains will be maintained 6 and 12 months later. Planned secondary analyses include an evaluation of the effects of BRIGHT, relative to Psychoeducation, on change to an earlier endogenous circadian phase and change in the timing and intensity of light exposure. Mediation analyses will examine whether improved sleep or a change in the timing of light exposure contributes to reduced risk in the five health domains. Moderation analyses of variation in intervention effect due to baseline demographics (gender, age, pubertal status), baseline sleep and other risk measures will also be evaluated. Multiple methods include self report, ecological momentary assessment, behavioral tasks and biologic measures. Multiple informers include youth, parent/s and teacher. This research is a first step within a longer-term plan to accelerate knowledge on the potentially powerful positive effects, for the developing neural system, of simple, disseminable psychosocial interventions specifically designed to target modifiable risk factors across adolescence.

Project narrative: There is an urgent need to identify modifiable mechanisms contributing to risk and vulnerability among youth. We test the hypothesis that eveningness, the tendency to go to sleep late and wake late, is an important contributor to, and even cause of, vicious cycles that escalate vulnerability and risk among youth. This study seeks to determine whether an intervention to reduce eveningness can reduce risk and confer resilience in critical aspects of health, development and functioning in youth.

Also, eveningness peaks at 15 years old and stays stable to 20 years old 6

**Outline of Introduction**

* Eveningness increases during adolescents and is an important correlate of both sleep problems and psychopathology.
* In a randomized controlled trial for which the 6-month follow-up data are reported here, we found that TranS-C was associated with greater improvement in sleep and circadian outcomes, relative to PE. In addition, TranS-C was associated with a few psychopathology outcomes, including XXX.
* “Although these findings on sleep and circadian outcomes are promising, we have not yet established whether the effects of TranS-C would be sustained over longer periods of time.” Studies of the longer-term effects of adolescent sleep intervention [insert a review of literature on long-term tx effects]

**Potential Topic Sentences:**

While the biological shift toward eveningness during puberty may be difficult to modify, we test the hypothesis that the psychosocial, behavioral and cognitive contributors are modifiable.

Interventions targeting the circadian tendency toward eveningness (‘night-owls’) in youth are important because eveningness is associated with sleep deprivation and increased risk for poorer health.

Our goal was to modify the psychosocial, behavioral and cognitive processes that

contribute to eveningness and a broad range of other sleep problems often comorbid with eveningness (e.g., insomnia) via the Transdiagnostic Sleep and Circadian Intervention for Youth (TranS-C).

Adolescents were selected for reporting an evening chronotype and falling into an ‘at risk’ range on measures of at least one of the five health domains reviewed above; namely, emotional, cognitive, behavioral, social, or physical.

The overarching

**The Current Study**

The goal of the current study is to investigate the long-term effects of a 6-week TranS-C treatment targeting eveningness and sleep problems in adolescents relative to psychoeducation (PE). The first aim was to examine the effect of TranS-C, compared to PE, on sleep and circadian outcomes from baseline through 6-month follow-up. The second aim was to examine the effect of TranS-C, compared to PE, on risks in five health domains from baseline through 6-month follow-up. We hypothesize that TranS-C would demonstrate greater improvement than PE from baseline to 6-month follow-up. The third aim was to explore potential moderators of TranS-C for primary and secondary outcomes, including age, sex, and the number of risk categories presented at baseline.

**Methods**

**Participants and Procedures**

Participants were recruited from January, 2013 to February, 2016 through advertisements and clinician referrals. Participants and parents or guardians were first screened via phone for eligibility, and potentially eligible individuals completed in-person assessment to determine eligibility. Parents or guardians of all participants provided informed consent and participants provided informed assent. Detailed description of the study procedure is reported elsewhere (Harvey et al., 2017). Participant flow is illustrated in *Figure 1*.

Inclusion criteria were: (a) were between 10 and 18 years old, living with a parent or guardian, and attending a class/job by 9am at least 3 days per week; (b) were fluent in English; (c) were able and willing to give informed assent; (d) reported eveningness as demonstrated by scoring within the lowest quartile of the Children’s Morningness-Eveningness Preferences Scale (CMEP; 27 or lower) (Dagys et al., 2012) and had a 7-day sleep diary showing a sleep onset time of 10:40pm or later for 10-13 year olds, 11pm or later for 14-16 year olds, and 11:20pm or later for 17-18 year olds at least 3 nights per week for the last 3 months; and e) participants must fall into an ‘at risk’ range on measures of at least one of the five health domains (see Table 1).

Exclusion criteria were: (a) an active, progressive physical illness or neurological degenerative disease directly related to the onset and course of the sleep disturbance; (b) evidence of obstructive sleep apnea, restless legs syndrome, or periodic limb movement disorder; (c) significantly impairing pervasive developmental disorder; (d) bipolar disorder, schizophrenia, or another current Axis I disorder if there was a risk of harm if treatment was delayed. Participants ceased taking medications that alter sleep (e.g., hypnotics) 4 weeks prior to the assessment (2 weeks for melatonin) or were excluded; and e) history of substance dependence in the past six months or current suicide risk sufficient to preclude treatment on an outpatient basis was exclusionary.

**Treatment Conditions**

Both treatments involved 6 individual, weekly 50-minute sessions delivered during the school year by doctoral or master-level therapists. Both treatments. A key difference between treatment conditions is that TranS-C promotes behavior change whereas PE only provides information without facilitating behavior change, and this treatment differentiation has been confirmed by coding. Full details about the treatment conditions are reported elsewhere (Harvey et al., 2017).

**Transdiagnostic Sleep and Circadian Intervention for Youth (TranS-C)** (Harvey, 2016; Harvey & Buysse, 2017).TranS-C was developed using a transdiagnostic approach rather than disorder-focused approach. TranS-C targets psychosocial, behavioral, and cognitive processes that maintain sleep and circadian problems in youth, and includes 4 cross-cutting modules, 4 core modules, and 7 optional modules. More information about modules?

**Psychoeducation (PE).** PE is an active control associated with sleep improvement (Harvey et al., 2015; bipolar pilot RCT). PE sessions focus on providing information about the interplay between sleep, stress, diet, health, exercise, accidents, and mood. Participants sample through mediation, yoga, and/or outdoor appreciation activities.

**Measures**

\*\*Adolescents and parents/guardians were screened via telephone. Eligible adolescents

completed a sleep diary for 7 nights to ascertain the presence of Inclusion (d). If met, an in-person assessment was conducted during which the KSADS and questionnaires were completed.

If the participant continued to meet criteria, the activities from this point forward were conducted within the school semester because holiday schedules differ markedly during adolescence40,41

All measures described below were collected at baseline, posttreatment, and 6-month follow-up assessment.

**Sleep and Circadian Outcomes**

***Sleep Diary.*** 7-days sleep diary was collected every morning via phoneby trained research assistants for the week leading up to the treatment, the week after treatment, and the week leading up to the 6-month follow-up assessment. Standardized sleep diary was used (Carney et al., 2012). The following variables are derived using sleep diary: 1) weeknight total sleep time (TST), calculated as XXX; 2) weeknight bedtime, derived by XXX; 3) weeknight-weekend discrepancy in TST; 4) weeknight-weekend discrepancy in bedtime; and 5) weeknight-weekend discrepancy in wakeup time. Weeknight TST and bedtime are primary outcomes.

***Children’s Morningness-Eveningness Preference Scale (CMEP; Carskadon et al., 1993).*** CMEP is a self-report measure of the degree of eveningness. The scores range from 10 (Extreme evening preference) to 43 (Extreme Morning Preference). CMEP score is a primary outcome.

***Sleepiness Scale.*** The sleepiness scalecontains ten items from the School Sleep Habits Survey comprising the Sleepiness Scale (Wolfson & Carskadon, 1998). Items were rated on a 4-point scale (0 = “No”, 1 = “Struggled to Stay Awake”, 2 = “Fallen Asleep”, 3 = Both “Strugg led to Stay Awake” and “Fallen Asleep”).

***Pittsburgh Sleep Quality Index (PSQI).*** The PSQI consists of 19 self-reported items on a 4-point scale assessing sleep in the past month (Buysse et al., 1989). Score ranges from 0 to 21 with higher scores indicating greater problems.

***CBCL Sleep Composite.*** A CBCL sleep composite was derived based on seven items on the parent-report CBCL (Achenbach & Rescorla, 2001) that measure sleep functioning (Becker, Ramsey, & Byars, 2015). Items were rated on a 3-point scale (0 =   
“Not True”, 1 = “Somewhat/Sometimes True”, 2 = “Very True/Often True”).

**Functioning in Five Health Domains.**

Two sets of composite scores were used to indicate functioning or risk in five health domains, namely youth self-reported composite risk scores and parent-reported composite risk scores. Both sets of composite scores was composed of measures of emotional, cognitive, behavioral, social, and physical health.

**Youth Self-Report Composite Risk Score.** Five composite scores, each composed of measures of emotional, cognitive, behavioral, social, and physical health, were used to indicate functioning in five health domains. The composite scores were calculated for each of the five health domains by taking the mean of standardized summary scores for specific measures within that domain. Summary scores for specific measures were reverse coded when necessary so that all scores of specific measures within a domain would have the same direction. Specific measures for each domain are listed below:

***Emotional domain***. Emotional domain was assessed by a composite of depressive and anxiety symptoms as measured by the Children’s Depression Rating Scale (CDRS; Poznanski et al., 1984) and the Multidimensional Anxiety Scale for Children (MASC; March, Sullivan, & Parker, 1999) respectively. The CDRS is 17-item rating scale with possible scores ranging from 17 to 113, and higher scores indicating depression. The MASC is a 39-item scale with possible scores ranging from 0 to 117, and higher scores indicating more anxiety.

***Cognitive domain***. Cognitive domain was assessed by a composite of the Attention Control Scale (ACS; Derryberry & Reed, 2002) and pertinent school-related items found in the

Youth Social Adjustment Scale – Self Report (YSAS; Weissman, Orvaschel, & Padian, 1980). The ACS is a 20-item questionnaire, whose scores range from 4 to 80, with higher scores demarcating better attention control. To keep the directionality of the present study we reverse coded the ACS so higher scores meant greater risk in the cognitive composite. We used 6 items from the YSAS, where higher scores indicated more cognitive and school problems.

***Behavioral domain***. Behavioral domain was measured by a composite of the Brief Sensation Seeking Scale (BSSS; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002) and theAlcohol and Substance Use Questionnaire (Johnston, Malley, Bachman, & Schulenberg, 2009). The BSSS is an 8-item questionnaire designed to assess the thrill and sensation seeking, with higher scores indication higher sensation seeking. TheAlcohol and Substance Use Questionnaire assess the use alcohol, caffeine, and recreational drugs in the past 30 days; moreover, we added extra questions on caffeine and energy drinks in this study. This measure used a 7-point rating scale with higher scores indicating more frequent use of the aforementioned substances. Greater risk in the behavioral domain is indicated by higher scores.

***Social domain***. Social domain was assessed by taking the average of the Youth Social Adjustment Scale – Self-Report (Weissman et al., 1980) subscales on friends, family, and romantic relationships. Higher scores in the social domain indicate more social impairment.

***Physical domain***. Physical domain was assessed by deriving a composite of the Physical Health Questionnaire-15(PHQ-15; Kroenke, Spitzer, & Williams, 2002) and the Modifiable Activity Questionnaire for Adolescents (MAQ; Aaron & Kriska, 1997). The PHQ-15 is a 15-item questionnaire with scores ranging from 0 to 30, more physical complaints are indicated by a higher score. MAQ is questionnaire designed to assess activity levels, with scores indicating number of hours active or exercising in a week. A higher score was indicative of a more active and exercise rich life. To maintain directionality of risk in the physical domain the PHQ-15 was reverse coded to combine with MAQ to generate a composite score. Thereafter, the composite was reverse coded as to have higher scores indicate higher risk in the physical domain.

**Parent-Reported Composite Risk Score via the Child Behavior Checklist (CBCL).** Parents were given the 113-item CBCL ( Achenbach & Rescorla, 2001)questionnaire to rate the behavioral and psychological functioning of their adolescent. Each item of the CBCL was on 3-point scale (0 = not true, 1 = somewhat/sometimes true, 2 = very true/often true), with higher scores signaling more problematic behaviors. The parent-reported composite risk score was derived using seven of the CBCL subscales. Anxious/Depressed and Withdrawn/Depressed subscales comprised the *Emotional Domain*. Thought and Attention subscales comprised the *Cognitive Domain*. Rule-Breaking and Aggressive Behavior subscales comprised the *Behavioral Domain*. Social Problems and Somatic Complaints subscales comprised the *Social and Physical Domains* respectively.

**Data Analysis**

Sample size was determined via power analysis. G\*Power 3.1 was used to estimate

sample size using Cohen’s d = 0.48 for primary outcomes, assuming significance of 0.05 and

power of at least 80%. Sixty-nine participants were needed for each condition. The final

recruitment allowed for at least 20% more for potential attrition (more detail in Supplement 6).

There were no interim analyses. The final sample size for the analysis was 176.

Data analysis was conducted in Stata 14 (StataCorp, 2015). All analyses were adjusted by

age and sex, which were the stratification factors used during randomization. Using intent-totreat64, multilevel modeling with maximum likelihood estimation with the assumption of missing at random was used to examine continuous outcomes. The fixed component of the model included stratification factors (age and sex), an indicator of time period (Time=0 pre-treatment, Time=1 post-treatment), an indicator for treatment condition (Treatment=1 TranS-C,

Treatment=0 PE), and a Time by Treatment interaction term. The random part of the model

included a subject-specific random intercept and a time and subject-specific error term. The

treatment effect of interest was the interaction, representing the difference in mean change from

pre-treatment to post-treatment between TranS-C and PE. The model also provided estimates of

the mean pre-to-post change in the PE condition (coefficient of Time) and in the TranS-C

condition (coefficient of Time plus interaction coefficient), and the significance of these changes

will also be reported regardless of the significance of the interaction because PE may be an active control and can be beneficial. Using Hochberg’s65 procedure, the outcomes are considered

two subfamilies of analyses. The error rate in each subfamily was controlled under 0.025 using

the Hochberg’s step-up procedure, so that the overall family-wise error rate did not exceed 0.05.

Data analysis was conducted in Stata 15. All analyses were adjusted by age and sex, which were the stratification factors used during the randomization. Intent-to-treat method was used. Multilevel modeling with maximum likelihood estimation was used to examine all continuous outcome variables. Missing at random was assumed. The fixed component of the model included an indicator of time period (Pre = 0, Post = 1), an indicator for treatment condition (TranS-C = 1, PE = 0), a time by treatment interaction term, and covariates (age and sex). The random part of the model included a subject-specific random intercept and a subject-specific error term. We tested adding random slope of time but for the majority of outcomes there was no evidence for this. The significance of treatment moderator was evaluated using three-way interaction between treatment condition, time, and the moderator. Multiplicity was corrected using Hochberg’s procedure. [Add more detail here XXX]

**Results**

**Demographic and Descriptive statistics**

*Figure 1* summarizes the flow of participants from baseline through 6-month follow-up. The attrition rate was X during treatment and at the 6-month follow-up. Attrition was not significantly different across treatment groups at posttreatment (TranS-C: XX, PE: XX, *p* = ) or at 6-month follow-up (TranS-C: XX, PE: XX, *p* =). Table X presents the descriptive statistics of all outcome variables.

**Aim 1. Sleep and Circadian Outcomes**

The primary sleep and circadian outcomes are TST weeknights, BT weeknights, and CMEP. Relative to PE, TranS-C was only associated with greater reduction in eveningness preference as indexed by greater increase in CMEP score from baseline through 6-month follow-up (*b* = 1.84, *p* = 0.006), and there was no significant difference between treatment conditions on CMEP from posttreatment to 6-month follow-up (*b* = -0.16, *p* = 0.83). There was no significant difference between treatment conditions on weeknight TST or BT from baseline to posttreatment or 6-month follow-up.

The secondary sleep and circadian outcomes are weeknight-weekend discrepancy in TST, BT and wakeup time, sleepiness, PSQI, and CBCL Sleep Composite. Wakeup time weeknight-weekend discrepancy, sleepiness, PSQI, and CBCL Sleep Composite all showed significant improvement for TranS-C relative to PE from baseline to posttreatment. The additional treatment gains associated with TranS-C relative to PE were maintained through 6-month follow-up for wakeup time weeknight-weekend (*b* = 0.72, *p* = 0.01) and PSQI (*b* = -1.09, *p* = 0.02), although there was no significant difference between treatment conditions from posttreatment to 6-month follow-up on these two measures. For sleepiness, both TranS-C and PE exhibited significant decrease from post to follow-up, so there was no advantage of TranS-C over PE by 6-month follow-up. For CBCL Sleep Composite, there was an increase for TranS-C and a decrease for PE from post to 6-month follow-up and thus at 6-month follow-up TranS-C no long had an advantage over PE.

**Aim 2**. **Five Health Risk Domains**

The primary health outcomes are the five youth self-report composite risk scores. None of the five youth self-report composite risk scores was significantly different between treatment conditions in terms of their changes from baseline to posttreatment and to 6-month follow-up. We have also presented analyses using specific measures within each health domain. TranS-C did not produce additional changes above and beyond PE on these measures. For the Attention Control Scale (ACS), there was a significant treatment by time interaction from posttreatment to 6-month follow-up (*b* = 0.79, *p* = 0.02) in favor of PE, such that PE had significantly more improvement in attention control (as indicated by an increase in ACS score) than TranS-C. However, none of the changes from baseline to posttreatment or 6-month follow-up were significant for TranS-C or PE (all *p*s> 0.05).

The secondary health outcomes are the parent-reported composite risk scores. None of the five parent-report composite risk scores was significantly different between treatment conditions from baseline to posttreatment or 6-month follow-up. There was a significant treatment by time interaction from posttreatment to 6-month follow-up in favor of PE, such that there was significantly more reduction in the parent-report composite scores in the behavioral domain for PE over TranS-C during that period, although there was no significant difference between treatment condition for the changes from baseline to 6-month follow-up. We also presented specific subscales within each domain. For the CBCL thought problem subscale, there was a significant advantage of TranS-C relative to PE from pre to post. However, by 6-month follow-up, this advantage has diminished. At 6-month follow-up, both TranS-C and PE exhibited a significant decrease of thought problems compared to pre (both *p*s < 0.002). TranS-C maintained the treatment gain for this outcome, but PE caught up from posttreatment to follow-up. For CBCL rule breaking behavior, there was a significant difference in the slopes of TranS-C vs. PE from post to 6-month follow-up. However, the changes from pre to post or follow-up were not significant for both TranS-C and PE (all *p*s > .05)

**Aim 3: Treatment Moderators**

Three moderators were tested: sex, age, and the number of risk domains present at baseline (participants met between one to five risk domains as part of the eligibility criteria at baseline).Tests ofthe treatment by time by moderator interaction for all outcome variables are presented in Table X.

Sex did not moderate the treatment effects from baseline to post or 6-month follow-up for any of the sleep and circadian outcomes, youth self-reported composite risk scores, or parent-reported composite risk scores.

For age, there was a significant 3-way interaction between treatment conditions, time period, and age for weeknight bedtime, *χ2*(2, *N* = 172) = 15.19, *p* = 0.0005. Specifically, the slope of age for TranS-C relative to PE was significantly steeper at 6-month follow-up versus baseline for weekday bedtime (*b* = 0.21, *p* = 0.016).

For the number of risk domains present at baseline, there was a significant treatment by time by risk domains interaction for youth self-report composite risk in behavioral domain, *χ2*(2) = 15.19, *p* = 0.0022. Specifically, the difference in the effects of risk domains at baseline on behavioral risk was significant comparing TranS-C versus PE during treatment phase (*b* = -0.21, *p* = 0.01) and through 6-month follow-up (*b* = -0.28, *p* = 0.001). We also explored the specific measures within the behavioral domain. The difference in the effects of risk domains at baseline on self-reported substance use comparing TranS-C versus PE was significant during treatment phase (*b* = -1.49, *p* = 0.045) and through 6-month follow-up (*b* = -2.80, *p* < 0.001).

\*need a table to report corrected *p*-values for the moderation section (Blake study has a table that can serve as a template)

\*interpret these effects and make graphs

\*see if post to follow-up would make more sense to report

**Discussion**

Table X

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | TranS-C | | | PE | | |
|  | Baseline | Post-treatment | 6-month follow-up | Baseline | Post-treatment | 6-month follow-up |
| Outcome | *Mean (SD)* | *Mean (SD)* | *Mean (SD)* | *Mean (SD)* | *Mean (SD)* | *Mean (SD)* |
| Sleep and Circadian Outcomes |  |  |  |  |  |  |
| SD-TST weeknights\* | 459.06 (64.92) | 482.76 (82.55) | 436.63 (58.15) | 454.96 (61.51) | 464.81 (76.01) | 430.57 (60.63) |
| SD-BT weeknights\* | 22.87 (1.07) | 22.85 (0.98) | 22.98 (1.16) | 22.99 (1.05) | 23.04 (1.12) | 22.94 (0.94) |
| SD-TST weeknight-weekend discrepancy | -70.39 (113.10) | -31.16 (115.19) | -74.21 (70.71) | -48.91 (89.28) | -56.46 (106.25) | -70.98 (133.91) |
| SD-BT weeknight-weekend discrepancy | -0.79 (1.23) | -0.68 (1.41) | -0.39 (0.98) | -0.58 (1.13) | -0.51 (1.09) | -0.55 (1.89) |
| SD-WUP weeknight-weekend discrepancy | -1.90 (1.36) | -1.13 (1.29) | -1.55 (1.19) | -1.42 (1.28) | -1.32 (1.55) | -1.78 (1.38) |
| Sleepiness | 6.20 (4.52) | 4.83 (4.03) | 3.56 (4.02) | 6.15 (4.01) | 6.37 (4.71) | 4.80 (4.84) |
| PSQI | 7.58 (2.99) | 5.85 (2.56) | 4.88 (3.03) | 7.58 (3.03) | 6.75 (3.48) | 6.00 (3.97) |
| CBCL Sleep Composite | 3.32 (2.03) | 1.84 (1.86) | 2.10 (2.14) | 3.24 (2.13) | 2.51 (1.91) | 2.11 (1.95) |
| CMEP\* | 21.11 (3.79) | 25.08 (4.86) | 25.33 (4.77) | 21.52 (3.86) | 23.61 (4.60) | 23.93 (4.32) |
|  |  |  |  |  |  |  |
| Youth Self-Report Composite Risk Score\* |  |  |  |  |  |  |
| *Emotional health:* |  |  |  |  |  |  |
| CDRS | 33.90 (9.34) | 27.01 (8.72) | 25.87 (7.68) | 33.08 (9.90) | 27.00 (8.16) | 26.63 (10.08) |
| MASC | 46.51 (17.73) | 45.45 (17.10) | 42.28 (20.28) | 45.98 (15.99) | 44.74 (18.03) | 40.63 (18.18) |
| Composite | 0.36 (0.90) | -0.07 (0.79) | -0.24 (0.82) | 0.28 (0.81) | -0.11 (0.79) | -0.25 (0.89) |
| *Cognitive health:* |  |  |  |  |  |  |
| ACS | 50.56 (8.23) | 52.18 (8.09) | 51.25 (8.67) | 51.24 (7.22) | 51.29 (7.77) | 52.70 (10.10) |
| YSAS (school/cognitive items) | 11.68 (2.95) | 11.69 (3.14) | 10.21 (3.65) | 11.90 (2.83) | 12.49 (2.94) | 10.68 (3.72) |
| Composite | 0.10 (0.79) | -0.001 (0.82) | -0.18 (0.75) | 0.07 (0.65) | 0.17 (0.80) | -0.19 (1.00) |
| *Behavioral health:* |  |  |  |  |  |  |
| Sensation Seeking Scale | 27.28 (5.97) | 27.35 (6.61) | 26.50 (6.45) | 26.36 (6.22) | 27.51 (7.04) | 25.96 (6.65) |
| Alcohol and Substance Use | 5.76 (8.24) | 5.51 (8.10) | 5.60 (7.93) | 5.67 (6.62) | 6.26 (8.37) | 5.46 (7.68) |
| Composite | 0.03 (0.80) | 0.02 (0.83) | -0.03 (0.79) | -0.04 (0.77) | 0.09 (0.92) | -0.08 (0.85) |
| *Social health:* |  |  |  |  |  |  |
| YSAS: Friends | 18.53 (4.58) | 17.73 (3.69) | 17.22 (4.21) | 18.81 (4.98) | 18.68 (4.82) | 17.12 (4.94) |
| YSAS: Family | 11.92 (3.50) | 11.33 (3.56) | 10.97 (3.29) | 12.34 (3.67) | 11.68 (4.17) | 10.74 (3.70) |
| YSAS: Romantic | 7.34 (2.03) | 7.62 (1.78) | 6.79 (2.41) | 7.59 (1.69) | 7.62 (1.85) | 6.80 (2.36) |
| Composite | 0.06 (0.59) | -0.0001 (0.60) | -0.20 (0.62) | 0.18 (0.70) | 0.11 (0.68) | -0.22 (0.72) |
| *Physical health:* |  |  |  |  |  |  |
| MAQ | 3.36 (5.35) | 4.20 (8.22) | 30.37 (44.18) | 2.83 (4.31) | 3.40 (5.11) | 22.22 (25.03) |
| PHQ | 9.30 (5.37) | 7.97 (5.01) | 6.42 (4.88) | 8.58 (4.40) | 7.01 (4.33) | 6.00 (5.09) |
| Composite | 0.20 (0.68) | 0.01 (0.87) | -0.25 (0.93) | 0.18 (0.58) | -0.02 (0.57) | -0.15 (0.63) |
|  |  |  |  |  |  |  |
| Parent-Reported Composite Risk Score |  |  |  |  |  |  |
| *Emotional Health* |  |  |  |  |  |  |
| Anxious/Depressed | 3.13 (3.48) | 2.61 (2.97) | 2.79 (3.22) | 4.11 (3.78) | 3.61 (3.56) | 3.36 (2.88) |
| Withdrawn/Depressed | 2.83 (2.84) | 2.49 (2.54) | 2.57 (2.88) | 3.14 (2.77) | 2.99 (2.72) | 3.09 (2.68) |
| Composite | -0.03 (0.94) | -0.17 (0.80) | -0.13 (0.92) | 0.17 (0.93) | 0.07 (0.89) | 0.05 (0.83) |
| *Cognitive Health* |  |  |  |  |  |  |
| Thought problems | 3.56 (2.59) | 2.38 (2.31) | 2.57 (2.78) | 3.75 (2.73) | 3.60 (2.90) | 2.92 (2.63) |
| Attention problems | 4.23 (3.61) | 4.01 (3.85) | 4.03 (3.86) | 4.17 (4.13) | 4.33 (4.30) | 4.07 (4.26) |
| Composite | 0.08 (0.80) | -0.16 (0.81) | -0.12 (0.90) | 0.11 (0.89) | 0.10 (0.96) | -0.05 (0.91) |
| *Behavioral Health* |  |  |  |  |  |  |
| Rule-Breaking Behavior | 1.91 (2.31) | 1.39 (1.87) | 1.97 (2.31) | 1.98 (2.16) | 2.31 (2.61) | 1.85 (2.33) |
| Aggressive Behavior | 3.84 (4.02) | 3.62 (4.22) | 3.84 (4.32) | 4.54 (4.52) | 3.76 (3.73) | 3.69 (3.85) |
| Composite | -0.005 (0.91) | -0.14 (0.86) | 0.01 (0.96) | 0.09 (0.88) | 0.07 (0.92) | -0.03 (0.87) |
| *Social Health* |  |  |  |  |  |  |
| Social Problems | 1.36 (1.52) | 1.24 (1.81) | 1.25 (1.72) | 1.86 (2.15) | 1.83 (2.49) | 1.44 (1.91) |
| Composite | -0.07 (0.77) | -0.13 (0.92) | -0.13 (0.88) | 0.18 (1.09) | 0.16 (1.27) | -0.03 (0.97) |
| *Physical Health* |  |  |  |  |  |  |
| Somatic Complaints | 2.89 (3.11) | 2.14 (2.75) | 1.94 (2.45) | 2.49 (2.74) | 2.01 (2.43) | 1.93 (2.12) |
| Composite | 0.24 (1.17) | -0.04 (1.04) | -0.12 (0.93) | 0.09 (1.04) | -0.09 (0.92) | -0.12 (0.80) |

Table X

*Descriptive Statistics of Outcome Variables*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | TranS-C | | | | | | PE | | | | |
|  | Baseline | Post-treatment | | | 6-month follow-up | | Baseline | Post-treatment | | 6-month follow-up | |
| Outcome | *Mean (SD)* | *Mean (SD)* | *d* | | *Mean (SD)* | *d* | *Mean (SD)* | *Mean (SD)* | *d* | *Mean (SD)* | *d* |
| Sleep and Circadian Outcomes | | | | | | | | | | | |
| TST weeknights\* | 459.06 (64.92) | 482.76 (82.55) | 0.37 | | 436.63 (58.15) | -0.35 | 454.96 (61.51) | 464.81 (76.01) | 0.16 | 430.57 (60.63) | -0.40 |
| BT weeknights\* | 22.87 (1.07) | 22.85 (0.98) | -0.03 | | 22.98 (1.16) | 0.10 | 22.99 (1.05) | 23.04 (1.12) | 0.04 | 22.94 (0.94) | -0.05 |
| TST weeknight-weekend discrepancy | -70.39 (113.10) | -31.16 (115.19) | 0.35 | | -74.21 (70.71) | -0.03 | -48.91 (89.28) | -56.46 (106.25) | -0.08 | -70.98 (133.91) | -0.25 |
| BT weeknight-weekend discrepancy | -0.79 (1.23) | -0.68 (1.41) | 0.09 | | -0.39 (0.98) | 0.32 | -0.58 (1.13) | -0.51 (1.09) | 0.06 | -0.55 (1.89) | 0.03 |
| WUP weeknight-weekend discrepancy | -1.91 (1.36) | -1.13 (1.29) | 0.58 | | -1.55 (1.19) | 0.26 | -1.42 (1.28) | -1.32 (1.55) | 0.08 | -1.78 (1.38) | -0.28 |
| Sleepiness | 6.20 (4.52) | 4.67 (3.98) | -0.34 | | 3.56 (4.02) | -0.58 | 6.15 (4.01) | 6.37 (4.71) | 0.06 | 4.80 (4.84) | -0.34 |
| PSQI | 7.58 (2.99) | 5.85 (2.56) | -0.58 | | 4.88 (3.03) | -0.90 | 7.58 (3.03) | 6.75 (3.48) | -0.28 | 6.00 (3.97) | -0.52 |
| CBCL Sleep Composite | 3.32 (2.03) | 1.84 (1.86) | -0.73 | | 2.10 (2.14) | -0.60 | 3.24 (2.13) | 2.54 (1.92) | -0.33 | 2.11 (1.95) | -0.53 |
| CMEP\* | 21.09 (3.76) | 25.08 (4.86) | 1.06 | | 25.33 (4.77) | 1.13 | 21.52 (3.86) | 23.44 (4.82) | 0.49 | 23.93 (4.32) | 0.62 |
|  |  |  |  | |  |  |  |  |  |  |  |
| Youth Self-Report Composite Risk Score\* | | | | | | | | | | | |
| *Emotional health* |  |  |  | |  |  |  |  |  |  |  |
| CDRS | 33.90 (9.34) | 27.01 (8.72) | -0.74 | | 25.87 (7.68) | -0.86 | 33.08 (9.90) | 27.00 (8.16) | -0.61 | 26.63 (10.08) | -0.65 |
| MASC | 46.51 (17.73) | 45.45 (17.10) | -0.06 | | 42.28 (20.28) | -0.24 | 45.98 (15.99) | 44.74 (18.03) | -0.08 | 40.63 (18.18) | -0.33 |
| Composite | 0.36 (0.90) | -0.07 (0.79) | -0.48 | | -0.24 (0.82) | -0.66 | 0.28 (0.81) | -0.11 (0.79) | -0.47 | -0.25 (0.89) | -0.65 |
| *Cognitive health* |  |  |  | |  |  |  |  |  |  |  |
| ACS | 50.56 (8.23) | 52.18 (8.09) | 0.20 | | 51.25 (8.67) | 0.08 | 51.24 (7.22) | 51.29 (7.77) | 0.01 | 52.70 (10.10) | 0.20 |
| YSAS (school/cognitive) | 11.68 (2.95) | 11.69 (3.14) | 0.00 | | 10.21 (3.65) | -0.50 | 11.90 (2.83) | 12.49 (2.94) | 0.21 | 10.68 (3.72) | -0.43 |
| Composite | 0.10 (0.79) | -0.001 (0.82) | -0.13 | | -0.18 (0.75) | -0.36 | 0.07 (0.65) | 0.17 (0.80) | 0.14 | -0.19 (1.00) | -0.40 |
| *Behavioral health* |  |  |  | |  |  |  |  |  |  |  |
| Sensation Seeking Scale | 27.28 (5.97) | 27.35 (6.61) | 0.01 | | 26.50 (6.45) | -0.13 | 26.36 (6.22) | 27.51 (7.04) | 0.18 | 25.96 (6.65) | -0.06 |
| Alcohol and Substance Use | 5.76 (8.24) | 5.51 (8.10) | -0.03 | | 5.60 (7.93) | -0.02 | 5.67 (6.62) | 6.26 (8.37) | 0.09 | 5.46 (7.68) | -0.03 |
| Composite | 0.03 (0.80) | 0.02 (0.83) | -0.02 | | -0.03 (0.79) | -0.08 | -0.04 (0.77) | 0.09 (0.92) | 0.16 | -0.08 (0.85) | -0.06 |
| *Social health* |  |  |  | |  |  |  |  |  |  |  |
| YSAS: Friends | 18.53 (4.58) | 17.73 (3.69) | -0.18 | | 17.22 (4.21) | -0.29 | 18.81 (4.98) | 18.68 (4.82) | -0.03 | 17.12 (4.94) | -0.34 |
| YSAS: Family | 11.92 (3.50) | 11.33 (3.56) | -0.17 | | 10.97 (3.29) | -0.27 | 12.34 (3.67) | 11.68 (4.17) | -0.18 | 10.74 (3.70) | -0.44 |
| YSAS: Romantic | 7.34 (2.03) | 7.62 (1.78) | 0.14 | | 6.79 (2.41) | -0.27 | 7.59 (1.69) | 7.62 (1.85) | 0.02 | 6.80 (2.36) | -0.47 |
| Composite | 0.06 (0.59) | -0.0001 (0.60) | -0.10 | | -0.20 (0.62) | -0.43 | 0.18 (0.70) | 0.11 (0.68) | -0.10 | -0.22 (0.72) | -0.58 |
| *Physical health* |  |  |  | |  |  |  |  |  |  |  |
| MAQ | 3.36 (5.35) | 4.20 (8.22) | 0.16 | | 5.31 (8.78) | 0.37 | 2.83 (4.31) | 3.40 (5.11) | 0.13 | 3.58 (3.97) | 0.17 |
| PHQ | 9.30 (5.37) | 7.97 (5.01) | -0.25 | | 6.42 (4.88) | -0.54 | 8.58 (4.40) | 7.01 (4.33) | -0.36 | 6.00 (5.09) | -0.59 |
| Composite | 0.20 (0.68) | 0.01 (0.87) | -0.27 | | -0.25 (0.93) | -0.67 | 0.18 (0.58) | -0.02 (0.57) | -0.34 | -0.15 (0.63) | -0.56 |
|  |  |  |  | |  |  |  |  |  |  |  |
| Parent-Reported Composite Risk Score | | | | | | | | | | | |
| *Emotional Health* |  |  |  |  | |  |  |  |  |  |  |
| Anxious/Depressed | 3.13 (3.48) | 2.61 (2.97) | -0.15 | 2.79 (3.22) | | -0.10 | 4.11 (3.78) | 3.61 (3.56) | -0.13 | 3.36 (2.88) | -0.20 |
| Withdrawn/Depressed | 2.83 (2.84) | 2.49 (2.54) | -0.12 | 2.57 (2.88) | | -0.09 | 3.14 (2.77) | 2.99 (2.72) | -0.06 | 3.09 (2.68) | -0.02 |
| Composite | -0.03 (0.94) | -0.17 (0.80) | -0.15 | -0.13 (0.92) | | -0.10 | 0.17 (0.93) | 0.07 (0.89) | -0.11 | 0.05 (0.83) | -0.13 |
| *Cognitive Health* |  |  |  |  | |  |  |  |  |  |  |
| Thought problems | 3.56 (2.59) | 2.38 (2.31) | -0.46 | 2.57 (2.78) | | -0.38 | 3.75 (2.73) | 3.60 (2.90) | -0.05 | 2.92 (2.63) | -0.30 |
| Attention problems | 4.23 (3.61) | 4.01 (3.85) | -0.06 | 4.03 (3.86) | | -0.05 | 4.17 (4.13) | 4.33 (4.30) | 0.04 | 4.07 (4.26) | -0.02 |
| Composite | 0.08 (0.80) | -0.16 (0.81) | -0.30 | -0.12 (0.90) | | -0.26 | 0.11 (0.89) | 0.10 (0.96) | -0.01 | -0.05 (0.91) | -0.19 |
| *Behavioral Health* |  |  |  |  | |  |  |  |  |  |  |
| Rule-Breaking Behavior | 1.91 (2.31) | 1.39 (1.87) | -0.22 | 1.97 (2.31) | | 0.03 | 1.98 (2.16) | 2.31 (2.61) | 0.16 | 1.85 (2.33) | -0.06 |
| Aggressive Behavior | 3.84 (4.02) | 3.62 (4.22) | -0.05 | 3.84 (4.32) | | 0.00 | 4.54 (4.52) | 3.76 (3.73) | -0.17 | 3.69 (3.85) | -0.19 |
| Composite | -0.005 (0.91) | -0.14 (0.86) | -0.15 | 0.01 (0.96) | | 0.01 | 0.09 (0.88) | 0.07 (0.92) | -0.02 | -0.03 (0.87) | -0.15 |
| *Social Health* |  |  |  |  | |  |  |  |  |  |  |
| Social Problems | 1.36 (1.52) | 1.24 (1.81) | -0.08 | 1.25 (1.72) | | -0.07 | 1.86 (2.15) | 1.83 (2.49) | -0.01 | 1.44 (1.91) | -0.19 |
| Composite | -0.07 (0.77) | -0.13 (0.92) | -0.08 | -0.13 (0.88) | | -0.07 | 0.18 (1.09) | 0.16 (1.27) | -0.01 | -0.03 (0.97) | -0.19 |
| *Physical Health* |  |  |  |  | |  |  |  |  |  |  |
| Somatic Complaints | 2.89 (3.11) | 2.14 (2.75) | -0.24 | 1.94 (2.45) | | -0.30 | 2.49 (2.74) | 2.01 (2.43) | -0.17 | 1.93 (2.12) | -0.20 |
| Composite | 0.24 (1.17) | -0.04 (1.04) | -0.24 | -0.12 (0.93) | | -0.30 | 0.09 (1.04) | -0.09 (0.92) | -0.17 | -0.12 (0.80) | -0.20 |

Table X

*Effect Sizes of Between Groups*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Between-group difference at each time point (TranS-C vs. PE) | | | Between-group treatment effect on change (TranS-C vs. PE) | | |
| Outcome | *d*pre | *d*post | *d*6m | *d*pre-post | *d*pre-6m | *d*post-6m |
| Sleep and Circadian Outcomes |  |  |  |  |  |  |
| SD-TST weeknights\* | 0.06 | 0.23 | 0.10 | 0.20 | 0.05 | -0.15 |
| SD-BT weeknights\* | -0.11 | -0.18 | 0.04 | -0.07 | 0.15 | 0.22 |
| SD-TST weeknight-weekend discrepancy | -0.21 | 0.23 | -0.03 | 0.43 | 0.21 | -0.22 |
| SD-BT weeknight-weekend discrepancy | -0.18 | -0.14 | 0.10 | 0.03 | 0.30 | 0.27 |
| SD-WUP weeknight-weekend discrepancy | -0.37 | 0.14 | 0.18 | 0.50 | 0.54 | 0.04 |
| Sleepiness | 0.01 | -0.39 | -0.28 | -0.39 | -0.25 | 0.15 |
| PSQI | 0.00 | -0.29 | -0.32 | -0.30 | -0.38 | -0.08 |
| CBCL Sleep Composite | 0.04 | -0.37 | 0.00 | -0.40 | -0.07 | 0.33 |
| CMEP\* | -0.11 | 0.34 | 0.31 | 0.57 | 0.51 | -0.06 |
|  |  |  |  |  |  |  |
| Youth Self-Report Composite Risk Score\* | | | | | | |
| *Emotional health:* |  |  |  |  |  |  |
| CDRS | 0.09 | 0.00 | -0.08 | -0.12 | -0.21 | -0.08 |
| MASC | 0.03 | 0.04 | 0.09 | 0.02 | 0.10 | 0.08 |
| Composite | 0.09 | 0.04 | 0.01 | -0.01 | -0.02 | -0.01 |
| *Cognitive health:* |  |  |  |  |  |  |
| ACS | -0.09 | 0.11 | -0.15 | 0.19 | -0.12 | -0.31 |
| YSAS (school/cognitive items) | -0.08 | -0.26 | -0.13 | -0.21 | -0.07 | 0.14 |
| Composite | 0.04 | -0.21 | 0.01 | -0.27 | 0.04 | 0.31 |
| *Behavioral health:* |  |  |  |  |  |  |
| Sensation Seeking Scale | 0.15 | -0.02 | 0.08 | -0.17 | -0.07 | 0.11 |
| Alcohol and Substance Use | 0.01 | -0.09 | 0.02 | -0.12 | 0.01 | 0.13 |
| Composite | 0.09 | -0.08 | 0.06 | -0.18 | -0.02 | 0.16 |
|  |  |  |  |  |  |  |
| *Social health:* |  |  |  |  |  |  |
| YSAS: Friends | -0.06 | -0.22 | 0.02 | -0.15 | 0.05 | 0.20 |
| YSAS: Family | -0.12 | -0.09 | 0.07 | 0.01 | 0.17 | 0.15 |
| YSAS: Romantic | -0.14 | 0.00 | 0.00 | 0.12 | 0.20 | 0.08 |
| Composite | -0.19 | -0.17 | 0.04 | 0.00 | 0.15 | 0.14 |
| *Physical health:* |  |  |  |  |  |  |
| MAQ | 0.11 | 0.12 | 0.25 | 0.03 | 0.19 | 0.17 |
| PHQ | 0.15 | 0.20 | 0.08 | 0.11 | 0.05 | -0.06 |
| Composite | 0.04 | 0.04 | -0.13 | 0.06 | -0.11 | -0.17 |
|  |  |  |  |  |  |  |
| Parent-Reported Composite Risk Score | | | | | | |
| *Emotional Health* |  |  |  |  |  |  |
| Anxious/Depressed | -0.27 | -0.31 | -0.19 | -0.02 | 0.10 | 0.12 |
| Withdrawn/Depressed | -0.11 | -0.19 | -0.19 | -0.06 | -0.07 | -0.01 |
| Composite | -0.22 | -0.28 | -0.21 | -0.04 | 0.03 | 0.06 |
| *Cognitive Health* |  |  |  |  |  |  |
| Thought problems | -0.07 | -0.47 | -0.13 | -0.40 | -0.08 | 0.32 |
| Attention problems | 0.02 | -0.08 | -0.01 | -0.10 | -0.03 | 0.07 |
| Composite | -0.03 | -0.30 | -0.08 | -0.30 | -0.07 | 0.23 |
| *Behavioral Health* |  |  |  |  |  |  |
| Rule-Breaking Behavior | -0.03 | -0.40 | 0.05 | -0.38 | 0.08 | 0.46 |
| Aggressive Behavior | -0.16 | -0.04 | 0.04 | 0.12 | 0.19 | 0.07 |
| Composite | -0.11 | -0.25 | 0.05 | -0.13 | 0.16 | 0.29 |
| *Social Health* |  |  |  |  |  |  |
| Social Problems | -0.27 | -0.27 | -0.10 | -0.07 | 0.12 | 0.19 |
| Composite | -0.27 | -0.27 | -0.10 | -0.07 | 0.12 | 0.19 |
| *Physical Health* |  |  |  |  |  |  |
| Somatic Complaints | 0.14 | 0.05 | 0.00 | -0.07 | -0.10 | -0.03 |
| Composite | 0.14 | 0.05 | 0.00 | -0.07 | -0.10 | -0.03 |

Table X

Test for Treatment by Time by Moderator (Sex, Age, or Risk Count at Baseline) 3-Way Interaction

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sex | | |  | Age | | |  | Number of Risk Domains at Baseline | | |
| Outcome | *df* | *χ2* | *p* |  | *df* | *χ2* | *p* |  | *df* | *χ2* | *p* |
| *Sleep and Circadian Outcomes* |  |  |  |  |  |  |  |  |  |  |  |
| TST weeknights\* | 2 | 1.81 | 0.40 |  | 2 | 1.17 | 0.56 |  | 2 | 0.68 | 0.71 |
| BT weeknights\* | 2 | 2.13 | 0.35 |  | 2 | 15.19 | 0.0005\*\* |  | 2 | 0.13 | 0.94 |
| TST weeknight-weekend discrepancy | 2 | 1.49 | 0.47 |  | 2 | 0.05 | 0.98 |  | 2 | 0.90 | 0.64 |
| BT weeknight-weekend discrepancy | 2 | 3.81 | 0.15 |  | 2 | 6.78 | 0.038 |  | 2 | 0.29 | 0.86 |
| WUP weeknight-weekend discrepancy | 2 | 2.01 | 0.37 |  | 2 | 2.47 | 0.29 |  | 2 | 0.86 | 0.65 |
| Sleepiness | 2 | 3.96 | 0.14 |  | 2 | 3.52 | 0.17 |  | 2 | 4.44 | 0.11 |
| PSQI | 2 | 2.66 | 0.26 |  | 2 | 3.28 | 0.19 |  | 2 | 0.09 | 0.96 |
| CBCL Sleep Composite | 2 | 2.73 | 0.26 |  | 2 | 0.34 | 0.84 |  | 2 | 3.02 | 0.22 |
| CMEP\* | 2 | 0.20 | 0.90 |  | 2 | 0.33 | 0.85 |  | 2 | 8.14 | 0.017 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| *Youth Self-Report Composite Risk Scores* |  |  |  |  |  |  |  |  |  |  |  |
| Emotional domain | 2 | 0.08 | 0.96 |  | 2 | 5.95 | 0.051 |  | 2 | 0.85 | 0.65 |
| Cognitive domain | 2 | 3.74 | 0.15 |  | 2 | 1.00 | 0.61 |  | 2 | 3.42 | 0.18 |
| Behavioral domain | 2 | 0.28 | 0.87 |  | 2 | 1.08 | 0.58 |  | 2 | 12.27 | 0.0022\*\* |
| Social domain | 2 | 2.64 | 0.27 |  | 2 | 4.83 | 0.09 |  | 2 | 2.49 | 0.29 |
| Physical domain | 2 | 1.40 | 0.50 |  | 2 | 0.64 | 0.72 |  | 2 | 0.60 | 0.74 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| *Parent-Report Composite Risk Scores* |  |  |  |  |  |  |  |  |  |  |  |
| Emotional domain | 2 | 1.07 | 0.59 |  | 2 | 0.03 | 0.99 |  | 2 | 4.16 | 0.13 |
| Cognitive domain | 2 | 2.01 | 0.37 |  | 2 | 0.84 | 0.66 |  | 2 | 3.02 | 0.22 |
| Behavioral domain | 2 | 1.24 | 0.54 |  | 2 | 0.18 | 0.91 |  | 2 | 3.93 | 0.14 |
| Social domain | 2 | 1.57 | 0.46 |  | 2 | 0.65 | 0.72 |  | 2 | 2.26 | 0.32 |
| Physical domain | 2 | 3.14 | 0.21 |  | 2 | 1.78 | 0.41 |  | 2 | 3.26 | 0.20 |

*Notes.* \*indicates primary outcomes of the RCT. The corrected significance level is 0.0026 based on either Hochberg (1988), Benjamin & Hochberg (1995), or Bonferroni correction for multiple testing within each subset of analysis (testing of moderating effects of sex, age, and risk domains are considered three subsets of analysis). \*\*indicates significant *p*-values after correction for multiplicity.

*Figure 1.* CONSORT Diagram Illustrating the Flow of Participants Through the Study

Lost to follow up (N=4)

**Reason:** 3 teens stopped responding to research staff; 1 teen thought the intervention was not helpful.

Lost to follow up (N=4)

**Reason:** 2 teens thought the intervention was not helpful; 1 teen family too busy to continue; 1 family emergency impeded continuing.

Lost to follow up (N=3)

**Reason:** 2 teens decided the study required a significant time commitment; 1 teen did not complete follow up due to a medical condition.

Discontinued intervention (N=1)

**Reason:** Family decided the study required a significant time commitment.

Lost to follow up (N=1)

**Reason:** Teen thought the intervention was not helpful.

Discontinued intervention (N=5)

**Reason:** 1 family voluntary withdrew from the study without an explanation; 4 teens decided the study required a significant time commitment.

## Enrollment

Excluded (N=220)

Not meeting inclusion criteria (N=154)

Refused to participate (N=66)

## Post Follow-Up

## Allocation

## 6-Month Follow-Up

Allocated to Trans-C (N=89)

Received allocated intervention (N=87)

Did not receive allocated intervention (N=2)

**Reason:** Families decided the study required a significant time commitment.

Allocated to PE (N=87)

Received allocated intervention (N=86)

Did not receive allocated intervention (N=1)

**Reason:** Family stopped responding to research staff.

Randomized (N=176)

Assessed for Eligibility (N=396)

Analyzed (N=89)

Excluded from Analysis (N=0)

Analyzed (N=87)

Excluded from Analysis (N=0)

## Analysis