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

The aim of the current study is to investigate the long-term effects of a 6-week TranS-C treatment vs. PE targeting eveningness and sleep problems in adolescents. We hypothesize that TranS-C would demonstrate greater improvement than PE from baseline to 6-month follow-up.

**Aim 1.** The first aim was to examine whether the advantage of TranS-C over PE on primary and secondary sleep and circadian outcomes was maintained through 6-month follow-up.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Treatment effect (TranS-C vs. PE) on change during the treatment phase | | | Treatment effect (TranS-C vs. PE) on change from baseline through 6-month follow-up | | | Treatment effect from post to follow-up (6mFU vs. post) | | |
|  | Coef. | *SE* | *p* | Coef. | *SE* | *p* | Coef. | *SE* | *p* |
| Sleep and Circadian Outcomes |  |  |  |  |  |  |  |  |  |
| TST weeknights\* | 12.98 | 11.56 | 0.26 | -0.75 | 11.62 | 0.95 | -13.73 | 11.83 | 0.25 |
| BT weeknights\* | -0.04 | 0.16 | 0.81 | 0.20 | 0.16 | 0.21 | 0.24 | 0.16 | 0.14 |
| TST weeknight-weekend discrepancy | 48.03 | 23.45 | 0.04 | 18.30 | 23.47 | 0.44 | -29.73 | 24.00 | 0.22 |
| BT weeknight-weekend discrepancy | 0.04 | 0.29 | 0.89 | 0.38 | 0.29 | 0.19 | 0.34 | 0.29 | 0.25 |
| WUP weeknight-weekend discrepancy | 0.70 | 0.29 | 0.02 | 0.72 | 0.29 | 0.01 | 0.02 | 0.29 | 0.95 |
| Sleepiness | -1.69 | 0.72 | 0.02 | -1.08 | 0.73 | 0.14 | 0.61 | 0.76 | 0.43 |
| PSQI | -0.99 | 0.47 | 0.04 | -1.09 | 0.48 | 0.02 | -0.10 | 0.49 | 0.84 |
| CBCL Sleep Composite | -0.76 | 0.29 | 0.01 | -0.06 | 0.30 | 0.85 | 0.70 | 0.30 | 0.02 |
| CMEP\* | 2.00 | 0.65 | 0.002 | 1.84 | 0.67 | 0.01 | -0.16 | 0.69 | 0.83 |

*Note*. \*indicates primary outcomes. All models adjusted for age and sex.

* The advantage of TranS-C vs. PE was maintained through 6-month follow-up for waketime weeknight-weekend discrepancy, PSQI, and CMEP.

TST weeknight-weekend discrepancy



Waketime weeknight-weekend discrepancy (absolute value)



PSQI



CMEP



\*TranS-C’s advantage over PE on CMEP was maintained through 6-month follow-up

* For sleepiness, both TranS-C and PE exhibited decrease from post to follow-up, so there was no advantage of TranS-C over PE from pre to follow-u
* For CBCL sleep composite, there was an increase from post to follow-up for TranS-C. At 6-month follow-up, TranS-C no long had an advantage over PE. 

**Aim 2.** The second aim was to examine the effects of TranS-C over PE on primary and secondary outcomes in the five health domains.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Treatment effect on change during the treatment phase | | | Treatment effect on change from baseline through 6-month follow-up | | | Treatment effect from post to follow-up (6mFU vs. post) | | |
|  | Coef. | *SE* | *p* | Coef. | *SE* | *p* | Coef. | *SE* | *p* |
| Youth Self-Report Composite Risk Score\* | | | | | | | | | |
| *Emotional health:* |  |  |  |  |  |  |  |  |  |
| CDRS | -0.54 | 1.35 | 0.69 | -1.22 | 1.36 | 0.37 | -0.68 | 1.38 | 0.64 |
| MASC | -0.89 | 2.13 | 0.68 | 1.41 | 2.18 | 0.52 | 2.29 | 2.20 | 0.30 |
| Composite | -0.01 | 0.10 | 0.90 | -0.02 | 0.10 | 0.82 | -0.01 | 0.10 | 0.92 |
| *Cognitive health:* |  |  |  |  |  |  |  |  |  |
| ACS | 1.28 | 1.15 | 0.27 | -1.31 | 1.17 | 0.26 | -2.59 | 1.20 | 0.03 |
| YSAS (school/cognitive) | -0.55 | 0.59 | 0.35 | -0.27 | 0.60 | 0.65 | 0.28 | 0.62 | 0.67 |
| Composite | -0.16 | 0.12 | 0.17 | 0.01 | 0.12 | 0.92 | 0.17 | 0.13 | 0.16 |
| *Behavioral health:* |  |  |  |  |  |  |  |  |  |
| Sensation Seeking Scale | -0.64 | 0.69 | 0.35 | -0.26 | 0.70 | 0.71 | 0.38 | 0.72 | 0.61 |
| Alcohol and Substance Use | -0.03 | 0.62 | 0.96 | 0.50 | 0.64 | 0.43 | 0.53 | 0.65 | 0.42 |
| Composite | -0.06 | 0.07 | 0.41 | 0.01 | 0.07 | 0.83 | 0.07 | 0.07 | 0.32 |
| *Social health:* |  |  |  |  |  |  |  |  |  |
| YSAS: Friends | -0.80 | 0.67 | 0.24 | 0.39 | 0.69 | 0.57 | 1.19 | 0.70 | 0.09 |
| YSAS: Family | 0.06 | 0.55 | 0.91 | 0.85 | 0.56 | 0.13 | 0.79 | 0.57 | 0.17 |
| YSAS: Romantic | 0.14 | 0.39 | 0.72 | 0.12 | 0.40 | 0.77 | -0.02 | 0.40 | 0.96 |
| Composite | -0.02 | 0.11 | 0.87 | 0.16 | 0.11 | 0.15 | 0.17 | 0.11 | 0.11 |
| *Physical health:* |  |  |  |  |  |  |  |  |  |
| MAQ | -0.22 | 5.67 | 0.97 | 4.97 | 5.85 | 0.40 | 5.19 | 5.99 | 0.39 |
| PHQ | 0.26 | 0.68 | 0.71 | -0.09 | 0.69 | 0.89 | -0.26 | 0.68 | 0.72 |
| Composite | -0.004 | 0.11 | 0.97 | -0.13 | 0.11 | 0.24 | -0.13 | 0.11 | 0.26 |
|  |  |  |  |  |  |  |  |  |  |
| Parent-Reported Composite Risk Score | | | | | | | | | |
| *Emotional Health* |  |  |  |  |  |  |  |  |  |
| Anxious/Depressed | -0.02 | 0.43 | 0.97 | 0.47 | 0.44 | 0.29 | 0.49 | 0.45 | 0.27 |
| Withdrawn/Depressed | -0.07 | 0.35 | 0.83 | -0.04 | 0.37 | 0.92 | 0.04 | 0.37 | 0.92 |
| Composite | -0.02 | 0.11 | 0.89 | 0.06 | 0.11 | 0.57 | 0.08 | 0.12 | 0.50 |
| *Cognitive Health* |  |  |  |  |  |  |  |  |  |
| Thought problems | -1.02 | 0.33 | 0.002 | -0.23 | 0.35 | 0.51 | 0.79 | 0.35 | 0.02 |
| Attention problems | -0.36 | 0.42 | 0.39 | 0.01 | 0.44 | 0.98 | 0.37 | 0.44 | 0.40 |
| Composite | -0.23 | 0.10 | 0.01 | -0.04 | 0.10 | 0.67 | 0.19 | 0.10 | 0.05 |
| *Behavioral Health* |  |  |  |  |  |  |  |  |  |
| Rule-Breaking Behavior | -0.71 | 0.30 | 0.02 | 0.30 | 0.32 | 0.34 | 1.01 | 0.32 | 0.002 |
| Aggressive Behavior | 0.58 | 0.47 | 0.22 | 0.93 | 0.49 | 0.06 | 0.35 | 0.49 | 0.49 |
| Composite | -0.08 | 0.11 | 0.45 | 0.18 | 0.11 | 0.10 | 0.26 | 0.11 | 0.02 |
| *Social Health* |  |  |  |  |  |  |  |  |  |
| Social Problems | -0.16 | 0.27 | 0.55 | 0.15 | 0.28 | 0.58 | 0.32 | 0.28 | 0.26 |
| Composite | -0.08 | 0.14 | 0.55 | 0.08 | 0.14 | 0.58 | 0.16 | 0.14 | 0.26 |
| *Physical Health* |  |  |  |  |  |  |  |  |  |
| Somatic Complaints | -0.25 | 0.37 | 0.50 | -0.34 | 0.38 | 0.37 | -0.10 | 0.38 | 0.81 |
| Composite | -0.09 | 0.14 | 0.50 | -0.13 | 0.14 | 0.37 | -0.04 | 0.14 | 0.81 |

*Note*. \*indicates primary outcomes. All models adjusted for age and sex.

* For ACS (attention control scale), there was a significant difference in the slopes of TranS-C vs. PE from post to 6-month follow-up. Higher score of ACS indicates better attention control. It appears that there that from post to follow-up, PE had an increase of ACS. However, the changes from pre to post or follow-up were not significant for both TranS-C and PE (all *p*s> 0.05). 
* For CBCL thought problem, there was a significant advantage of TranS-C over 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 post 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.** Moderation?

The third aim was to examine whether sex and age moderated the effects of TranS-C over PE on the outcomes.

\*Should we do this for all outcomes or just the ones with positive findings? I’m leaning towards testing for all outcomes and make appropriate adjustment. What did you do for 12-mo paper?

\*Another check in point: In order to say tx gain was maintained, we should look for either a significant tx by time interaction from pre to follow-up or from post to follow-up. Does this seem correct to you?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 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) |