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Parent–School Digital Health Education for Reducing Screen Time and Improving Sleep Quality, Somatic Symptoms, and Academic Engagement in Adolescents

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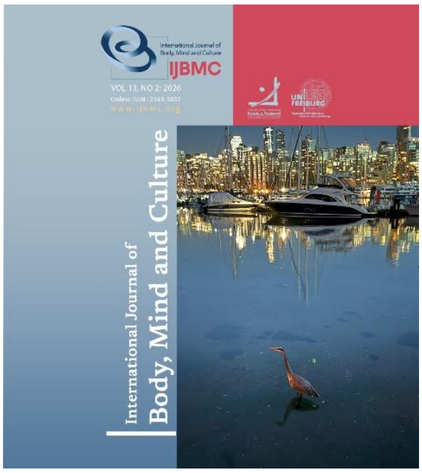

ABSTRACT

Objective: This study evaluated the effectiveness of a culturally adapted parent–school digital health education program in reducing adolescents' screen time and improving sleep quality, somatic symptoms, and academic engagement.

Methods and Materials: This quasi-experimental pretest–posttest study included a waitlist control group. The intention-to-treat sample comprised 240 adolescents aged 12–17 years from eight secondary schools, assigned to an intervention group (n = 121) or a waitlist control group (n = 119). The intervention included 6–8 weekly parent–student sessions focused on family media rules, bedtime screen reduction, sleep hygiene, self-regulation, and healthy alternatives to screen-based leisure. Outcomes were daily screen time, sleep quality, somatic symptoms, and academic engagement. Data were analyzed using mixed-effects models.

Findings: Compared with controls, the intervention group showed a greater reduction in daily screen time (adjusted Δ = −62.8 minutes/day, 95% CI: −79.4 to −46.2, $p < 0.001$, d = 0.66). Sleep quality improved significantly (Δ = −1.37, $p < 0.001$, d = 0.58), somatic symptoms decreased (Δ = −3.7, $p < 0.001$, d = 0.39), and academic engagement increased (Δ = +0.15, p = 0.001, d = 0.34). Higher adherence to family media rules strengthened effects on screen time and sleep quality.

Conclusion: Parent–school digital health education significantly reduced screen time and improved sleep, somatic symptoms, and academic engagement in adolescents.

Keywords: Adolescents, Screen Time, Sleep Wake Disorders, Somatic Symptoms, Health Education.

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Introduction

Digital media have become embedded in adolescents' daily routines for learning, social connection, entertainment, and self-expression. At the same time, the rapid expansion of smartphone-based and social media use has intensified concerns in health psychology and educational psychology about "discretionary" screen time—especially evening and bedtime use—and its potential downstream effects on sleep, physical complaints, and school functioning. Contemporary reviews emphasize that screen exposure is not a single behavior (it varies by timing, content, context, and whether it is active/interactive or passive), yet a consistent theme is that heavier use—particularly around bedtime—can displace sleep and impair recovery processes that are foundational for both health and learning (Stiglic & Viner, 2019).

Sleep is a central pathway through which digital behaviors may influence health and academic adjustment. Adolescence is characterized by developmental shifts in circadian timing and sleep–wake regulation that increase vulnerability to late bedtimes and insufficient sleep, even under typical school schedules (Crowley et al., 2007). Professional consensus recommendations generally indicate that adolescents need adequate nightly sleep (often operationalized as ~8–10 hours) to support optimal functioning (Paruthi et al., 2016). However, insufficient sleep is common, and the public health and pediatric literature repeatedly links inadequate sleep to impairments in mood, attention, self-regulation, and daytime functioning (Owens et al., 2014).

A substantial body of observational research links screen time to delayed bedtimes, shorter sleep duration, and poorer sleep outcomes among youth. In a systematic literature review focusing on school-aged children and adolescents, most studies reported adverse associations between screen time and sleep outcomes, most consistently shorter sleep duration and delayed timing (Hale & Guan, 2015). Similarly, a narrative review of electronic media and youth sleep identified delayed bedtime and shorter total sleep time as the most consistent correlates across television, computer use, electronic gaming, and mobile phone activity (Cain & Gradisar, 2010).

Several mechanisms plausibly explain these associations. First, screen activities can directly displace sleep by extending the time in bed spent awake ("time displacement"). Second, many digital activities increase cognitive and emotional arousal (e.g., messaging, competitive gaming, emotionally laden content), which may delay sleep onset. Third, exposure to short-wavelength ("blue-enriched") light in the evening can suppress melatonin and delay circadian phase, increasing alertness at a time when the body is preparing for sleep. Experimental evidence supports the biological plausibility of this pathway: a controlled study comparing evening reading on light-emitting devices versus printed materials found delayed circadian timing, reduced melatonin secretion, longer sleep-onset latency, and reduced next-morning alertness in the light-emitting condition (Chang et al., 2015). Taken together, these findings suggest that interventions aimed at reducing adolescents' screen time—particularly in the pre-sleep window—may improve sleep quality by supporting earlier bedtimes, reducing physiological and cognitive arousal, and minimizing circadian disruption.

Sleep is not only restorative; it is tightly linked to bodily comfort and symptom perception. Many adolescents report somatic symptoms such as headaches, abdominal pain, musculoskeletal aches, fatigue, and other "medically unexplained" or stress-sensitive complaints that sit at the intersection of health psychology, emotion regulation, and family/school stressors. Importantly, experimental evidence indicates that insufficient sleep can *increase* somatic complaints. In a within-subject crossover experiment, restricting adolescents' time in bed to levels typical of the school week produced significantly greater frequency and severity of somatic complaints than a sufficient-sleep condition (Krietsch et al., 2020).

Screen time may relate to somatic symptoms both directly (e.g., sedentary behavior, posture-related strain, eye strain, stress reactivity to online experiences) and indirectly via sleep disruption. In addition, emerging evidence suggests that the *type* of screen time matters. For example, research differentiating between passive (e.g., watching) and active (e.g., gaming, interactive use) screen behaviors indicates that these forms may show different associations with psychosomatic complaints in adolescents (Khan et al., 2022). This distinction strengthens the rationale for educational programs that go beyond "total screen hours" and explicitly teach families and schools to target high-risk patterns (e.g., late-night, highly arousing, or unstructured use) while supporting developmentally appropriate, purposeful digital engagement.

The educational consequences of adolescent sleep disruption are well documented. Sleep supports attention, working memory, emotional regulation, and executive functioning—capacities central to classroom learning and sustained effort. A meta-analytic review found that sleepiness, sleep quality, and sleep duration each showed significant (though modest) associations with school performance, with sleepiness demonstrating the strongest relationship (Dewald et al., 2010). These findings align with broader models of school engagement that conceptualize engagement as behavioral (participation, persistence), emotional (belonging, interest), and cognitive (investment, strategic learning) components (Fredricks et al., 2004).

Screen time may undermine academic engagement through multiple pathways. First, screen use can displace time for homework, reading, and sleep. Second, fragmented attention from frequent notifications and multitasking may reduce sustained focus and perceived efficacy. Third, poor sleep can amplify daytime fatigue and irritability, increasing disengagement and reducing willingness to participate. Therefore, academic engagement is a theoretically coherent and practically meaningful outcome when evaluating screen-time reduction programs: it captures not only achievement but also the motivational and behavioral processes through which students connect to learning.

Because adolescents' screen behavior is shaped by multiple settings, effective prevention and intervention efforts often require coordinated action across home and school contexts. Ecological and developmental perspectives emphasize that behavior change is more likely when consistent expectations, skills, and supports are provided by the key social systems surrounding the adolescent (Bronfenbrenner, 1979). At home, parents influence screen behavior through modeling, rule-setting, monitoring, and autonomy-supportive guidance (Valkenburg et al., 2013). At school, policies, classroom norms, and digital literacy curricula can either reinforce or undermine healthy technology habits.

Clinical and public health guidance frequently recommends that families create structured expectations and media rules. The American Academy of Pediatrics has emphasized the importance of intentional media use and family media planning for school-aged children and adolescents (COMMUNICATIONS, 2016). However, translating guidance into consistent practice is not straightforward. For example, a randomized clinical trial testing the completion of a family media use plan did not yield statistically significant improvements in adolescent media rule engagement, suggesting that "planning tools" may require stronger implementation support, motivational components, and contextual tailoring (Moreno et al., 2021). This evidence underscores the potential value of a *parent–school* program that combines education with practical strategies, shared norms, and coordinated reinforcement—rather than relying on families to implement change in isolation.

School-based and community interventions can reduce screen time, but the effects are often small to moderate and vary across age groups and program components. A meta-analysis of school interventions reported a significant overall effect in reducing screen time among youth, supporting the feasibility of prevention efforts delivered through educational settings (Friedrich et al., 2014). However, adolescence introduces distinct challenges: greater autonomy, stronger peer influence, and higher reliance on smartphones for social life. Adolescent-focused trials have illustrated both promise and complexity. For instance, the "Switch-Off 4 Healthy Minds" cluster randomized controlled trial integrated student seminars, eHealth messaging, behavioral contracting, and parental newsletters; while screen time declined in both intervention and control groups, between-group differences were not statistically significant, and results highlighted the importance of motivational targets (Babic et al., 2016). Collectively, these findings suggest that adolescent programs may need (a) stronger parent–school alignment, (b) clearer emphasis on *timing* and *sleep-protective* routines, and (c) culturally resonant messaging and strategies.

Another gap is outcome integration. Many screen-time studies focus on obesity, physical activity, or mental health symptoms, whereas fewer trials simultaneously evaluate sleep quality, somatic symptoms, and academic engagement—three outcomes that sit at the intersection of health psychology and educational functioning and that plausibly share sleep as a key mechanism.

Digital health education is never culturally neutral. Norms around parenting authority, adolescent autonomy, family routines, school–parent collaboration, and acceptable technology use differ across societies and subcultures. If intervention content assumes a particular parenting style, communication pattern, or school infrastructure, effectiveness may be reduced when implemented in a new cultural setting. Cultural adaptation frameworks distinguish between surface structure (language, examples, materials) and deep structure (values, meanings, relational norms) elements that influence acceptability and behavior change (Resnicow et al., 1999). A complementary ecological validity approach argues that effective adaptations attend to multiple dimensions of fit, including language, persons, metaphors, content, concepts, goals, methods, and broader context (Bernal et al., 1995).

Accordingly, a culturally adapted parent–school digital health education program should not only translate content but also align recommendations with local family routines, school practices, and culturally meaningful motivations (e.g., academic success, family harmony, well-being), while preserving the evidence-based "active ingredients" (e.g., limiting bedtime screens, strengthening self-regulation skills, supporting consistent rules and autonomy-supportive negotiation).

Against this background, the present culturally adapted trial evaluates a parent–school digital health education program designed to reduce adolescents' discretionary screen time, with particular emphasis on evening and sleep-sensitive use. The program targets shared knowledge (sleep and health literacy related to digital media), practical behavior-change strategies (structured routines, goal setting, and environmental supports such as device-free bedrooms), and coordinated reinforcement across home and school contexts. We examine the program's effects on three outcomes highly relevant to health psychology and educational psychology: sleep quality, somatic symptoms, and academic engagement.

Based on prior observational and experimental evidence linking screen exposure to sleep disruption (Chang et al., 2015; Hale & Guan, 2015) and linking insufficient sleep to increased somatic complaints and reduced school functioning (Dewald et al., 2010; Krietsch et al., 2020), we hypothesize that adolescents in the intervention condition will show (1) improved sleep quality, (2) reduced somatic symptoms, and (3) higher academic engagement relative to controls. We further propose that reductions in evening/bedtime screen time will partially mediate improvements in sleep quality, which in turn may contribute to reductions in somatic symptoms and enhanced academic engagement.

Methods and Materials

Study Design

This study used a culturally adapted parent–school digital health education program and evaluated it using a quasi-experimental pretest–posttest design with a waitlist control condition. The evaluation and reporting were structured to align with transparent reporting principles for nonrandomized intervention studies (Des Jarlais et al., 2004), and intervention components were documented in sufficient detail to enable replication consistent with the TIDieR guidance (Hoffmann et al., 2014). Cultural adaptation procedures followed widely used public health and psychosocial treatment adaptation concepts emphasizing both "surface" and "deep" cultural structure to maximize acceptability and ecological validity (Bernal et al., 1995; Resnicow et al., 1999).

Setting and participants

Participants were recruited from public and semi-public secondary schools. Schools were selected to represent variability in neighborhood socioeconomic characteristics while maintaining comparable educational schedules and technology policies. Eligible adolescents were students aged 12–17 years enrolled in participating schools and living with at least one parent/guardian willing to participate in the program's parent-facing elements. Adolescents were eligible if they reported regular use of a personal smartphone or daily access to a screen-based device outside of school hours. Exclusion criteria were limited to conditions that would prevent participation in group-based educational sessions or completion of study measures (for example, severe cognitive impairment reported by the school counselor or parent). Because the program emphasized bedtime routines and sleep-protective media habits, adolescents receiving active medical treatment for severe sleep disorders were not excluded; rather, they were asked to maintain stable treatment during the program so that changes could be interpreted with caution in sensitivity analyses.

Recruitment and allocation procedures

School administrators disseminated study information through parent messaging channels and student announcements. Interested families attended a brief orientation meeting in which researchers described study goals, confidentiality procedures, and participation expectations. After baseline assessment, schools were allocated to either the intervention condition or the waitlist control condition to minimize contamination across students within the same school. Allocation was conducted at the school level based on practical scheduling constraints and to balance school size and grade composition across conditions. The waitlist design ensured that families assigned to the control condition were offered the program after the post-intervention assessments were completed.

Cultural adaptation process

Cultural adaptation was implemented through an iterative process integrating stakeholder input and content refinement. Initial adaptation focused on surface structure, including language level, examples reflecting locally common school routines, and parent–adolescent communication norms (Resnicow et al., 1999). Deep structure adaptation addressed culturally embedded meanings attached to academic success, family cohesion, parental authority, adolescent autonomy, and the social role of smartphones in peer relationships, consistent with ecological validity principles (Bernal et al., 1995). A small advisory group composed of school counselors, teachers, parents, and adolescents reviewed each session plan for clarity, acceptability, and feasibility. Feedback was incorporated to refine the metaphors, role-play scenarios, and homework tasks to better align with real-life family schedules and school demands. A pilot delivery with a small group (not included in the evaluation sample) was conducted to test barriers to timing, comprehension, and participation; minor revisions were made to session pacing and the homework burden before the main trial.

Intervention description

The intervention consisted of 6–8 weekly sessions delivered in school facilities outside standard class time. Sessions were co-facilitated by trained mental health or health education professionals with experience in adolescent and family group work. Each session combined brief psychoeducation, guided discussion, and skill practice, and it regularly included a short joint component for parents and adolescents, followed by structured breakout activities and a unified closing segment. Core program content targeted the reduction of discretionary screen time, with a particular focus on evening and bedtime use, and promoted sleep-protective routines consistent with pediatric media guidance emphasizing intentional use and family planning (COMMUNICATIONS, 2016).

The program emphasized three interlinked behavior-change targets. The first target was family media structure, implemented through collaborative rule-setting, clear device boundaries in high-risk time windows (especially the hour before bed), and planning for exceptions without escalating conflict. Families were guided to create a realistic, written media routine that reflected academic responsibilities, cultural norms around family gatherings, and household constraints. The second target was sleep hygiene and circadian-friendly habits, including consistent bed and wake times, wind-down routines, and minimizing alerting content before sleep. The third target was adolescent self-regulation skills that help maintain screen goals under peer pressure and boredom, including coping strategies, “urge surfing” style techniques for impulsive checking, and replacement activities. School collaboration components included short teacher-facing briefings on reinforcing device boundaries during study periods, consistent messaging from counselors, and optional classroom reminders about sleep and attention. Families received brief handouts summarizing session themes and were encouraged to practice between-session tasks, such as establishing a device-charging location outside the bedroom and tracking bedtime phone use.

Control condition

Waitlist control participants continued with usual school routines and received no structured sessions during the intervention period. To reduce attrition and maintain engagement, control families received a neutral brochure on adolescent well-being that did not include specific instructions on screen reduction or sleep scheduling. After post-intervention data collection, the full program was implemented in the control schools.

Measures

Primary and secondary outcomes were assessed via a combination of adolescent self-report questionnaires and objective or semi-objective indicators when available. Daily screen time was assessed using two complementary methods. Adolescents recorded their typical daily screen time using a short self-report measure that distinguished weekdays from weekends. When feasible, adolescents also provided weekly screenshots or logs from built-in device tracking features (e.g., smartphone "screen time" dashboards) to reduce recall bias; the study team standardized these records into minutes per day and used them as corroborative indicators rather than as the sole metric, given variability across devices and settings.

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), a widely used self-report instrument assessing sleep quality and disturbances over the prior month (Buysse et al., 1989). The PSQI global score was used as the primary sleep outcome, with higher scores indicating poorer sleep quality. Somatic symptoms were assessed using the revised Children's Somatization Inventory (CSI-24), which is designed to capture the severity of common pediatric somatic complaints and has been psychometrically evaluated (Walker et al., 2009). Academic engagement was measured using the Student Engagement Instrument (SEI), which assesses cognitive and psychological constructs of engagement relevant to persistence and school connection among secondary school students (Appleton et al., 2006). In addition to the main outcomes, perceived adherence to family media rules was assessed as a process indicator to quantify the extent to which families implemented the agreed-upon routines, consistent with the program's emphasis on parent–adolescent co-regulation and structured boundaries.

Demographic and contextual covariates included adolescent age, grade, gender, parental education, household composition, and baseline academic indicators (self-reported grade average or, where available, school-reported grade band). Because family functioning can influence both media behavior and engagement, brief measures of parent–adolescent communication quality and parental monitoring were also collected as potential confounders in exploratory analyses.

Data collection procedure

Data were collected at baseline (one to two weeks before the first session) and immediately post-intervention (one to two weeks after the final session). Assessments were administered in quiet school rooms in small groups supervised by a researcher who provided standardized instructions and responded to procedural questions without influencing answers. Parents completed parent-facing measures separately, either on paper during school-based parent meetings or via secured electronic forms, depending on school preferences. To reduce social desirability, participants were reminded that responses were confidential, would not be shared with teachers, and would be analyzed in aggregate.

Fidelity monitoring and implementation indicators

To ensure consistent delivery, facilitators used session checklists and completed brief post-session fidelity notes capturing content covered, time allocation, group participation issues, and deviations from the manual. A subset of sessions was observed by a senior supervisor who rated adherence and facilitation quality using a structured rubric aligned with the session plans. Attendance was recorded for both adolescents and parents. Homework completion was tracked through brief self-report check-ins at the beginning of each session, focusing on whether families implemented the agreed media boundary for the week and any barriers encountered. These implementation indicators were used to describe feasibility and to explore whether adherence moderated changes in outcomes.

Ethical considerations

Ethical approval was obtained from the appropriate institutional review board/ethics committee prior to recruitment. Written informed consent was obtained from parents/guardians, and assent was obtained from adolescents. Participation was voluntary, and families could withdraw at any time without academic consequences. Participants who reported severe sleep problems, significant distress, or other health concerns during data collection were provided with referral information to school counseling services or local clinical resources.

Statistical analysis plan

Analyses were conducted using an intention-to-treat approach, including all participants with baseline data, regardless of session attendance, to reduce bias due to differential dropout. Primary analyses estimated group differences in change from baseline to post-intervention using mixed-effects modeling to account for clustering at the school level and repeated measures within individuals. Models included fixed effects for time, group, and the group-by-time interaction as the key estimate of intervention impact, with random intercepts for school and participant. Baseline covariates were included when they improved model fit or addressed meaningful baseline imbalance. For interpretability, standardized effect sizes were computed from model-estimated marginal means.

Missing data were examined for patterns consistent with missing-at-random. When appropriate, multiple imputation was used for questionnaire-scale missingness, and sensitivity analyses compared results with complete-case models. Additional exploratory analyses tested whether adherence to family media rules moderated intervention effects and whether changes in screen time statistically mediated changes in sleep quality, consistent with the program's hypothesized mechanism; mediation models were treated as exploratory given the two-wave design.

Findings and Results

A total of 278 parent–adolescent dyads expressed interest and were screened. Of these, 252 met eligibility criteria and completed baseline assessment; 12 were excluded after baseline due to incomplete consent or withdrawal prior to allocation. The final intention-to-treat (ITT) sample comprised N = 240 adolescents (Intervention = 121; Waitlist Control = 119) from 8 schools. Post-intervention data were obtained from 221 participants (92.1% retention). Missing posttest data were handled within mixed-effects models under a missing-at-random assumption. The two groups were comparable on demographic variables and baseline outcomes. Mean age was 14.6 years (SD = 1.5), and 52.1% of the sample identified as girls. Baseline screen time, sleep quality, somatic symptoms, and academic engagement did not differ significantly between groups (all p-values> .10). Table 1 summarizes demographic characteristics.

Table 1

Baseline demographic characteristics (ITT sample)

Characteristic	Intervention (n=121)	Control (n=119)	Test
Age, years, M (Babic et al.)	14.6 (1.6)	14.5 (1.5)	t(238)=0.52, p=.603
Girls, n (%)	64 (52.9)	61 (51.3)	χ^2(1)=0.06, p=.804
Two-parent household, n (%)	94 (77.7)	89 (74.8)	χ^2(1)=0.28, p=.597
Parent education ≥ college, n (%)	49 (40.5)	44 (37.0)	χ^2(1)=0.33, p=.565
Smartphone owned (yes), n (%)	109 (90.1)	106 (89.1)	χ^2(1)=0.06, p=.808

Baseline outcome values are presented in Table 2. Mean adolescent attendance in the intervention arm was 6.6 sessions (SD = 1.1) out of 8. Parent attendance averaged 5.4 sessions (SD = 1.6). Facilitator checklists indicated high delivery fidelity (M = 91.3% of planned components delivered per session; SD = 5.8%). At posttest, 72.7% of intervention families reported consistently applying at least two planned media rules (e.g., device-free bedroom and a bedtime cut-off), compared with 28.6% in the control group.

Table 2

Baseline outcomes by group (ITT sample)

Outcome	Intervention M (Babic et al.)	Control M (Babic et al.)	Test
Daily screen time (min/day)	298.4 (94.6)	304.7 (97.8)	t(238)=0.52, p=.604
PSQI global score	7.52 (2.41)	7.44 (2.36)	t(238)=0.26, p=.793
CSI-24 (somatic symptoms)	25.8 (10.2)	26.4 (10.5)	t(238)=0.45, p=.655
SEI total (academic engagement; 1–4)	2.53 (0.44)	2.50 (0.46)	t(238)=0.54, p=.590

Mixed-effects models (random intercepts for school and participant) showed a significant group × time interaction for daily screen time, indicating greater reductions in the intervention group relative to controls. Model-estimated means indicated that the intervention group decreased from approximately 300 minutes/day at baseline to 226 minutes/day at posttest, whereas controls showed a smaller decline to 286 minutes/day. The adjusted between-group difference in change was −62.8 minutes/day (95% CI [−79.4, −46.2], p < .001), corresponding to d = 0.66**.**

To examine measurement convergence, a subset of participants (n = 164) provided device-based screen-time logs. The correlation between self-reported screen time and device logs at baseline was r = .71, suggesting acceptable agreement for use as the primary measure.

For sleep quality, the group × time interaction was significant. The intervention group showed greater improvement (lower PSQI scores) than controls. For somatic symptoms (CSI-24), intervention participants reported a greater decrease in symptom severity than controls. For academic engagement (SEI), the intervention group demonstrated a modest but significant increase compared to controls. Table 3 provides model-estimated means and standardized effects for all outcomes.

Table 3

Intervention effects from mixed-effects models (model-estimated marginal means; ITT)

Outcome	Baseline M Intervention	Post M	Change	Baseline M Control	Post M	Change	ΔChange (I–C)	95% CI	p	Effect size (d)
Screen time (min/day)	298.9	226.4	−72.5	305.1	286.0	−19.1	−62.8	[−79.4, −46.2]	<.001	0.66
PSQI global	7.50	5.72	−1.78	7.43	7.02	−0.41	−1.37	[−1.86, −0.88]	<.001	0.58
CSI-24	25.9	20.8	−5.1	26.3	24.9	−1.4	−3.7	[−5.6, −1.8]	<.001	0.39
SEI total (1–4)	2.53	2.74	+0.21	2.50	2.56	+0.06	+0.15	[+0.06, +0.24]	.001	0.34

Note. ΔChange (I–C) indicates the adjusted difference in change between groups. Positive values reflect greater improvement in the intervention group for SEI; negative values reflect greater improvement (reductions) in the intervention group for screen time, PSQI, and CSI-24. An exploratory moderation model indicated that adherence strengthened intervention effects on screen time and sleep. In the intervention group, participants reporting high adherence (top tertile) showed a larger reduction in screen time (estimated −92.3 min/day) than those with low adherence (bottom tertile; estimated −46.1 min/day), with a significant adherence × time interaction (p = .004). A parallel pattern was observed for PSQI improvement (p = .012), suggesting that consistent home implementation amplified sleep benefits.

An exploratory two-wave mediation model examined whether reductions in screen time statistically accounted for improvements in sleep quality. The indirect effect of group assignment on posttest PSQI through change in screen time was significant (standardized indirect effect = −0.12, 95% bootstrapped CI [−0.20, −0.05]), while a direct effect remained (standardized direct effect = −0.19, p < .001). These results are consistent with partial mediation, indicating that reducing screen time contributed meaningfully to improved sleep. However, other program components (e.g., sleep hygiene, self-regulation) likely also played a role. Results were consistent when controlling for baseline covariates (age, gender, parent education) and when restricting analyses to participants with complete posttest data. Intraclass correlations (ICCs) at baseline indicated modest clustering by school (ICCs ranged from .02 to .05 across outcomes), supporting the use of multilevel models.

Discussion and Conclusion

Acknowledgments

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Declaration of Helsinki, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

References

Appleton, J. J., Christenson, S. L., Kim, D., & Reschly, A. L. (2006). Measuring cognitive and psychological engagement: Validation of the Student Engagement Instrument. *Journal of School Psychology*, *44*(5), 427-445. https://doi.org/10.1016/j.jsp.2006.04.002

Babic, M. J., Smith, J. J., Morgan, P. J., Lonsdale, C., Plotnikoff, R. C., Eather, N., Skinner, G., Baker, A. L., Pollock, E., & Lubans, D. R. (2016). Intervention to reduce recreational screen-time in adolescents: Outcomes and mediators from the 'Switch-Off 4 Healthy Minds'(S4HM) cluster randomized controlled trial. *Preventive Medicine*, *91*, 50-57. https://doi.org/10.1016/j.ypmed.2016.07.014

Bernal, G., Bonilla, J., & Bellido, C. (1995). Ecological validity and cultural sensitivity for outcome research: Issues for the cultural adaptation and development of psychosocial treatments with Hispanics. *Journal of Abnormal Child Psychology*, *23*(1), 67-82. https://doi.org/10.1007/BF01447045

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press. https://doi.org/10.4159/9780674028845

Buysse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*, *28*(2), 193-213. https://doi.org/10.1016/0165-1781(89)90047-4

Cain, N., & Gradisar, M. (2010). Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep medicine*, *11*(8), 735-742. https://doi.org/10.1016/j.sleep.2010.02.006

Chang, A.-M., Aeschbach, D., Duffy, J. F., & Czeisler, C. A. (2015). Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. https://doi.org/10.1073/pnas.1418490112*Proceedings of the National Academy of Sciences*, *112*(4), 1232-1237.

COMMUNICATIONS, C. O. (2016). Media use in school-aged children and adolescents. *Pediatrics*, *138*(5), e20162592. https://doi.org/10.1542/peds.2016-2592

Crowley, S. J., Acebo, C., & Carskadon, M. A. (2007). Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep medicine*, *8*(6), 602-612. https://doi.org/10.1016/j.sleep.2006.12.002

Des Jarlais, D. C., Lyles, C., Crepaz, N., & Group, T. (2004). Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. *American journal of public health*, *94*(3), 361-366. https://doi.org/10.2105/AJPH.94.3.361

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration, and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep medicine reviews*, *14*(3), 179-189. https://doi.org/10.1016/j.smrv.2009.10.004

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of educational research*, *74*(1), 59-109. https://doi.org/10.3102/00346543074001059

Friedrich, R. R., Polet, J. P., Schuch, I., & Wagner, M. B. (2014). Effect of intervention programs in schools to reduce screen time: a meta-analysis. *Jornal de Pediatria (Versão em Português)*, *90*(3), 232-241. https://doi.org/10.1016/j.jpedp.2013.09.003

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep medicine reviews*, *21*, 50-58. https://doi.org/10.1016/j.smrv.2014.07.007

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., Altman, D. G., Barbour, V., Macdonald, H., & Johnston, M. (2014). Better reporting of interventions: the Template for Intervention Description and Replication (TIDieR) checklist and guide. *Bmj*, *348*. https://doi.org/10.1136/bmj.g1687

Khan, A., Lee, E.-Y., Janssen, I., & Tremblay, M. S. (2022). Associations of passive and active screen time with psychosomatic complaints of adolescents. *American Journal of Preventive Medicine*, *63*(1), 24-32. https://doi.org/10.1016/j.amepre.2022.01.008

Krietsch, K. N., King, C. D., & Beebe, D. W. (2020). Experimental sleep restriction increases somatic complaints in healthy adolescents. *Sleep medicine*, *73*, 213-216. https://doi.org/10.1016/j.sleep.2020.07.020

Moreno, M. A., Binger, K. S., Zhao, Q., & Eickhoff, J. C. (2021). Effect of a family media use plan on media rule engagement among adolescents: a randomized clinical trial. *JAMA pediatrics*, *175*(4), 351-358. https://doi.org/10.1001/jamapediatrics.2020.5629

Owens, J., Group, A. S. W., Adolescence, C. o., Au, R., Carskadon, M., Millman, R., Wolfson, A., Braverman, P. K., Adelman, W. P., & Breuner, C. C. (2014). Insufficient sleep in adolescents and young adults: an update on causes and consequences. *Pediatrics*, *134*(3), e921-e932. https://doi.org/10.1542/peds.2014-1696

Paruthi, S., Brooks, L. J., D'Ambrosio, C., Hall, W. A., Kotagal, S., Lloyd, R. M., Malow, B. A., Maski, K., Nichols, C., & Quan, S. F. (2016). Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine. *Journal of Clinical Sleep Medicine*, *12*(6), 785-786. https://doi.org/10.5664/jcsm.5866

Resnicow, K., Baranowski, T., Ahluwalia, J. S., & Braithwaite, R. L. (1999). Cultural sensitivity in public health: defined and

demystified. *Ethnicity & disease*, 10-21. https://www.jstor.org/stable/45410142
Stiglic, N., & Viner, R. M. (2019). Effects of screentime on the health and well-being of children and adolescents: a systematic review of reviews. *BMJ open*, *9*(1), e023191. https://doi.org/10.1136/bmjopen-2018-023191
Valkenburg, P. M., Piotrowski, J. T., Hermanns, J., & De Leeuw, R. (2013). Developing and validating the perceived parental media mediation scale: A self-determination perspective. *Human Communication Research*, *39*(4), 445-469. https://doi.org/10.1111/hcre.12010
Walker, L. S., Beck, J. E., Garber, J., & Lambert, W. (2009). Children's Somatization Inventory: psychometric properties of the revised form (CSI-24). *Journal of Pediatric Psychology*, *34*(4), 430-440. https://doi.org/10.1093/jpepsy/jsn093