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Can a Personalized App Help Teens Build Healthier Sleep Habits? Findings from the PATH-S Feasibility Study

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Background

Adequate sleep is vital for overall health, especially for teens experiencing significant emotional, hormonal, and physical changes. Teens require 8 to 10 hours of sleep per night to support proper growth and development[1–3] because sleep supports brain development, learning, emotional regulation, and physical health.[4] When teens receive sufficient sleep, they demonstrate better attention, improved academic performance, stronger information processing, and more stable moods.[5] However, many teens struggle to obtain adequate sleep due to disruptions in their sleep patterns. Mobile devices frequently used by teens, such as phones, tablets, and laptops, emit blue light that interferes with the body's production of melatonin, the hormone that regulates sleep.[6] In addition, teens frequently face shifting academic workloads, late extracurricular activities, and social demands that may also disrupt consistent sleep schedules. As a result, teens average only about seven hours of sleep per night,[7] below the recommended amount essential for proper growth and development. Chronic sleep deprivation can have significant long-term consequences for both mental and physical health. Sleep-deprived teens are more likely to experience mood swings, develop anxiety or depression, and engage in risky behaviors such as driving while drowsy.[5] Over time, persistent lack of sleep can also increase the risk of cardiovascular disease, disrupt hormone regulation, and negatively affect diet patterns and insulin sensitivity.[4] Given these wide-ranging and serious effects, it is important to explore practical ways to address and improve teen sleep habits.

Although many teens recognize the importance of sleep and express interest in improving their sleep habits, they may not possess practical strategies for improving sleep quality or maintaining healthy routines. Previous research suggests that while teens may attempt behavior changes such as reducing

nighttime screen use or going to bed earlier, these efforts are often inconsistent without guidance, motivation, and reinforcement. To address this gap, KDHRC developed the Personalized Approach To Habits – Sleep (PATH-S) app, a digital intervention specifically for teens, designed to support healthy sleep behaviors through personalized microhabits, reminders, interactive content, and gamified engagement strategies.

Building on a previous brief that described the PATH-S program development and usability study, this brief provides the results of an early feasibility evaluation of the intervention among teen users.

Methods

Recruitment and study population

The PATH-S feasibility study used a two-group, randomized, pretest/posttest design to explore changes in the knowledge, self-efficacy, habit achievement, habit resilience, and sleep duration of teens after exposure to the PATH-S app. The study also assessed cues to action, which are internal or external triggers that encourage individuals to adopt healthy behaviors. In the context of sleep, internal cues may include recognizing the effects of insufficient sleep and feeling motivated to improve sleep habits, while external cues may include receiving text reminders to practice healthy sleep behaviors. KDHRC partnered with community organization to distribute recruitment materials and conducted in-person outreach with teens at sporting events, youth groups, and places where teens gather. KDHRC also implemented a referral program where participants were encouraged to refer friends to the study. All recruitment and evaluation materials were offered in English-only.

Eligibility criteria for participating teens included: (1) between the ages of 12 to 17; (2) English-speaking; (3) access to an audiovisual meeting program such as Zoom, and computer, and high-speed Internet; (4) a smartphone and the ability to download and use an app; and (5) living in the United States.

Data collection

The study included 220 eligible and 147 enrolled participants. After completing the eligibility and consent forms, participants were randomized into either the control or treatment group using a 1:1 randomization. All participants then completed a pretest survey that included questions on sleep and habit knowledge, attitudes/beliefs, self-efficacy, and sleepiness, and then attended a kickoff call to learn more about the study. All participants were subsequently mailed a Fitbit device and instructions for downloading the PATH-S app to their personal smartphone. Fitbit devices were used to objectively collect sleep-related measures including sleep duration, sleep timing, and nighttime wakefulness.

Participants randomized to the treatment group received access to the PATH-S app. The PATH-S app included personalized microhabit recommendations, daily surveys, interactive text messages, a dashboard displaying sleep trends and streaks, a space-themed serial sleep story unlocked through engagement, and customizable reminder prompts tied to participants' selected habits. Participants randomized to the control group received access to a control app that included only daily surveys and reminder prompts.

Throughout the 28-day study period, participants used their assigned app and completed daily in-app sleep surveys assessing bedtime, sleep duration, sleep quality, asthma symptoms, and completion of targeted sleep habits. App engagement metrics, including survey completion and habit tracking, were also monitored throughout the study. At the conclusion of the study period, participants completed a posttest survey, which included questions on sleep and habit knowledge, attitudes/beliefs, self-efficacy, and sleepiness.

Results

Data analysis was limited to participants who completed both the pretest and posttest, so after dropping participants with only pretest surveys and participants who engaged in less than half of the study activities, a total of 87 participants were included in the analysis (n=40 treatment group; n=47 control group). After analyzing the data, KDHRC found no significant differences between treatment and control groups for any of the demographic or personal characteristic variables or outcome measures at pretest, suggesting equivalency of the groups.

At posttest, the treatment group demonstrated significantly higher scores for knowledge ($p < .001$), cues to action ($p < .001$), and self-efficacy ($p = .041$); the control group also showed increases in knowledge but not at a significant level. Teens that engaged with PATH-S showed the knowledge and confidence to improve their sleep, as well as a greater ability to respond to or recognize sleep cues. These are important precursors to better quality sleep. Being female ($\beta = 0.108$, $p < 0.05$) and coming from a higher income family ($\beta = 0.607$, $p < 0.05$) were demographic characteristics associated with stronger outcomes, giving us important information on how to optimize the content of PATH-S to reach and support all populations as we continue its development.

While Fitbit sleep data analysis is ongoing, these initial findings are meaningful for several key reasons. First and foremost, improved sleep quantity and quality in teens are closely linked to better mental health, academic performance, and overall well-being. For parents, the results highlight the value of supporting healthy sleep habits at home, while for the broader community, they underscore how effective interventions can contribute to healthier, more resilient youth populations. Together, the outcomes demonstrate that investing in teen sleep health can have benefits that extend beyond the individual to families and society as a whole.

Discussion

The findings from the feasibility study suggest that the PATH-S app shows promise as a digital intervention for improving sleep-related outcomes among youth. Teens in the treatment group demonstrated significant gains in sleep knowledge, cues to action, and self-efficacy after using the PATH-S app for 28 days. These outcomes are particularly important because they address several of the core barriers identified in the background literature: while teens may recognize the importance of sleep, they often lack the practical knowledge, motivational strategies, and confidence needed make lasting behavior changes. By improving these, PATH-S may help bridge the gap between youth's desires to sleep better and their ability to consistently apply healthy sleep habits that can help them achieve their goals.

The increase in cues to action is especially notable because behavior change often depends on reminders or environmental triggers of some kind to encourage health choices before they become habitual.[8] The PATH-S app included interactive text messages, a dashboard, and a sleep story that revealed one scene at a time as teens completed their habits, all of which helped reinforce participants' awareness of their routines and completion of their healthy sleep habits. Interestingly, the control group also showed improvements in knowledge and cues to action, which may indicate that even minimal engagement through daily surveys and reminders can encourage increased engagement in heathy behaviors by tracking habits and receiving reminders to complete the habits. However, only the treatment group demonstrated a significant improvement in self-efficacy, suggesting that the additional interactive features of the PATH-S app may be necessary to build the necessary confidence in one's ability to practice and maintain new sleep habits, thus improving the ability and quality of sleep.

Limitations should be considered when interpreting these findings. First, the final analytic sample was reduced because of participant attrition and incomplete engagement which may limit generalizability. Second, the study duration was 28 days and did not include additional follow-up, making it difficult to determine whether observed changes would continue over time. Third, many outcomes were collected from self-reported survey data which may be subject to recall or response bias. To this end, the planned future studies will include larger and more diverse samples, longer follow-up periods, and additional sleep outcomes to better evaluate the longer-term effectiveness of the PATH-S intervention.

Overall, the PATH-S feasibility study provides encouraging evidence that an app-based health intervention can positively impact youth's sleep related knowledge, motivation, and self-efficacy. The findings highlight the potential for digital interventions like PATH-S to make sleep health education more engaging and accessible to teens, providing an opportunity to support healthy sleep habits through technology. Furthermore, these findings provide a foundation for KDHRC to continue developing and expanding the PATH-S app. As such, KDHRC plans to incorporate additional interactive content to further engage teens to establish healthier sleep habits, and pursue funding for larger evaluations of the impact of the PATH-S app.

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