Number 45 ■ March 2026

Evaluating Personalized Approach to Habits – Sleep: An App Designed to Improve Teen Sleep Habits

Divya M. Mathew, MPH,[1] Alyssa R. Jackson, M.Ed.,[1] Elizabeth R. Phelps,[1] Adam J. Boiman, MS, MPH,[1] Nicole I. Wanty, MAA,[1] Morgan L. Fleming, MPH,[1] Kristen D. Holtz, PhD[1]

Authors' Affiliation:

1. KDH Research & Communication

Background

Digital health interventions, including mobile applications and wearable devices such as Fitbits, offer promising opportunities to support health behavior change among teens by helping them build and maintain positive habits.[1] Digital health interventions often emphasize self-monitoring, goal setting, and behavioral feedback to prompt beneficial behavior change in alignment with the principles of control theory. Control theory describes behavior regulation as an ongoing process of setting goals, monitoring progress, receiving feedback, and adjusting behaviors accordingly.[2] By helping teens track their behaviors and understand their progress toward personal goals, digital interventions may support the development of the self-regulation skills needed to prompt and sustain behavior change by making behavioral data immediately accessible. A growing body of research has shown that wearable devices can serve as both measurement tools and mechanisms for behavior change. (Research Brief 41 provides additional information about the role of wearable devices as a method to promote behavior change and monitor health outcomes).

Digital health interventions may be particularly useful for improving sleep health among teens. 76.8% of high school students report not getting enough sleep, defined as 7 hours or less per night.[3] Although many teens recognize that insufficient sleep can leave them feeling grouchy or irritable, they may be less aware of sufficient sleep's broader effects on daily life, including their level of academic achievement, alertness in the classroom, and performance in extracurricular activities.[4–6] Indeed, for teens in particular, adequate sleep is critical for daily performance and long-term health, including memory consolidation, emotional regulation, and physical development.[7–10] Many teens express a desire to improve their sleep,[7] but recognizing the importance of sleep does not necessarily translate

into consistent healthy sleep behaviors.[4] Teens may be willing to adopt healthier habits, such as maintaining regular bedtimes, limiting late-night screen use, and adjusting daily routines, but not able to create good sleep habits because they lack the knowledge, skills, or support needed to establish and sustain them.[5,7,8,11]

Gaps in sleep education and lack of access to practical guidance may limit healthy sleep habits,[12,13] but digital health interventions can offer education about sleep hygiene and teens' circadian rhythms, support goal setting and self-monitoring, and encourage behaviors such as maintaining consistent bedtimes and limiting late-night screen use.[14] To fill educational gaps and increase access to practical guidance, KDH Research & Communication (KDHRC) developed the **P**ersonalized **A**pproach **T**o **H**abits – **S**leep (PATH-S) app. The PATH-S app combines wearable sleep tracking with casual gaming features (e.g., unlocking story elements as teens meet sleep goals) and intermittent reinforcement (e.g., earning streaks for healthy sleep behaviors) to encourage teens to develop and maintain healthier sleep habits. The PATH-S app connects with a Fitbit to track sleep metrics and reinforce progress toward sleep goals. By combining self-monitoring with engaging educational features and habit-forming feedback, the PATH-S app aims to help teens build sleep-related knowledge, strengthen their confidence in their ability to improve their sleep, and reinforce healthier sleep behaviors. To ensure the app's design and features met the needs of its intended audience, KDHRC took a multistep approach to develop and evaluate PATH-S whereby we: (1) developed a minimally viable prototype (prototype) of the app; (2) conducted usability testing with teens to assess its usability, acceptability, and engagement to obtain insights for app refinement; and (3) conducted feasibility testing. This brief describes development and usability testing of the PATH-S app. Forthcoming Brief No. 46 describes the feasibility testing outcomes.

Development and testing

PATH-S prototype app development

KDHRC developed a wireframe of the PATH-S prototype app. Below, we detail the main components of the PATH-S prototype app.

1) **Microhabits:** After downloading the app, users completed an introductory quiz assessing sleep routines, common challenges, motivators, and available resources. Based on the user's responses, the app generated personalized recommendations for microhabit selection. This section allowed teens to review and select three sleep microhabits to incorporate into their daily life (microhabits are simple actions requiring less than 10 minutes per day). The microhabit section of PATH-S displayed each user's chosen goal time for completing microhabits and explained how push notification reminders were linked to these preferences (See Figure 1).

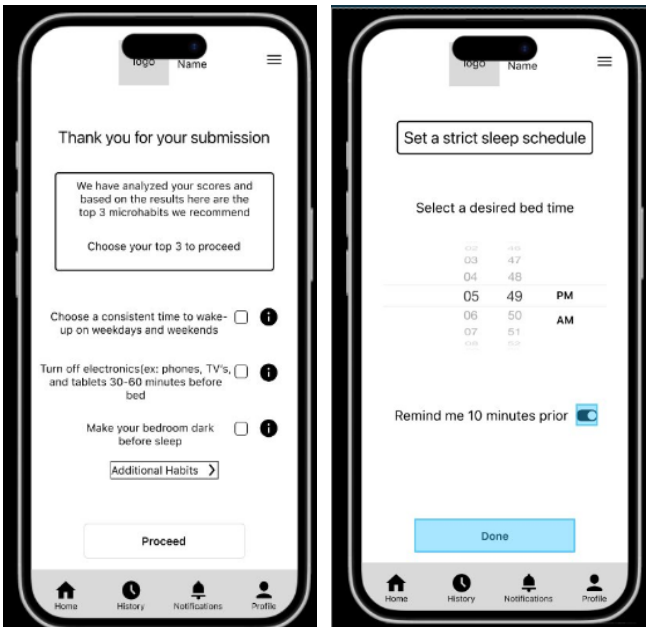

Figure 1. Example of the PATH-S prototype app's microhabits selection and reminders.

2) **Daily survey and interactive messages:** Users were prompted to complete a daily survey upon

opening the app. The survey assessed prior-night sleep duration, adherence to selected microhabits, perceived sleep quality, and other related factors. After completion, users were encouraged to review progress on the dashboard and unlock the next segment of the space-themed story. Participants also received up to two daily text messages containing sleep tips, trivia, and habit reinforcement content.

3) **Story:** This feature presented an illustrated, multi-chapter, space-themed narrative designed to promote engagement and reinforce continued app use. Completion of the daily survey unlocked new chapters, images, and narrative elements of the story.

4) **Dashboard:** The dashboard displayed weekly visualizations of sleep patterns, including a 7-day sleep duration chart and a streak counter for daily survey completion. The dashboard also showcased badges and rewards earned through consistent engagement (See Figure 2).

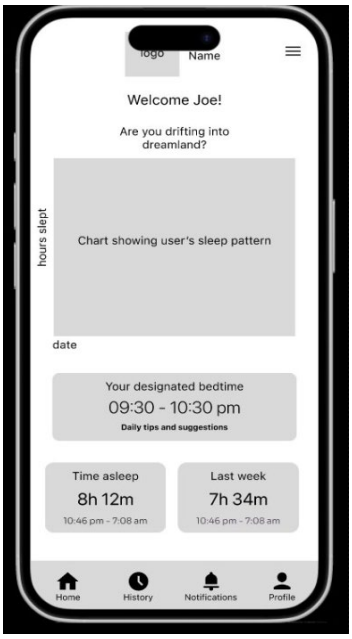

Figure 2. Example of the PATH-S prototype app's dashboard showing the user's sleep progress.

Usability testing with teens

After the prototype was finalized and internally tested, we conducted an investigation with the teen participants to explore the usability, acceptability, and engagement of the app for the intended audience. Topics in the 90-minute semi-structured qualitative interview guide included an open-ended review of the PATH-S prototype app, an explanation of the app's features, and a discussion of its acceptability and engagement. KDHRC recruited teens (aged 14-17) through social media and convenience sampling.

Eligibility criteria for participating teens included: (1) between the ages of 14 to 17; (2) able to speak and understand English; (3) access to an audiovisual meeting program such as Zoom, a computer, and the Internet; (4) access to a smartphone and the ability to download and use an app; and (5) resident of the United States.

Results

The usability study included 19 eligible, six enrolled, and four completed participants. KDHRC met its recruitment goals with a sample that included an equal distribution by sex (50% male and 50% female), and an age range from 15 to 17. Furthermore, past reviews of usability tests report diminishing returns on large sample sizes and suggest that usability tests with fewer than five users yield the best results.[15,16] Interview sessions were hosted via Zoom and audio recorded with added closed captions. Closed captions and audio recordings were then transcribed and analyzed using Atlas.ti for common themes.

After reaching feedback saturation at four participants, KDHRC did not schedule additional interview sessions. Overall, KDHRC received positive feedback from participants on the app's features and usability. Participants found the PATH-S prototype app both useful and easy to understand; they also appreciated that the app felt personalized with suggestions for participants based on how they responded to the quizzes. Users valued the informative nature of the features, especially the app's ability to provide a weekly review of recent sleep hours and habits. However, participants identified a

few areas for improvement, including clearer quiz wording, enhanced visual appeal through additional colors and font options, and more intuitive sleep-tracking features with more descriptive labels and greater customization (see Table 1 for quotes from usability study participants). Beyond these suggestions, participants saw potential for PATH-S to positively influence teenager's sleep behaviors.

When asked to rate the prototype app using a Likert-scale of *1 – very low* to *10 – very high*, participants scored the prototype positively across all usability and content areas (see Table 2). These consistently high ratings suggest a strong user experience with only minor areas for potential improvement.

Table 1. Usability study participant feedback	
Features	*"I liked the habit selection because the information would help improve my sleep" - Female, 17*
Usability	*"I liked the way it's written, easy to understand, intriguing" - Male, 17*
Information	*"I liked how it tells us what time we go to sleep on those specific days and if we look at that chart, we can go to sleep at a better time" - Female, 17*
Personalization	"I liked that the habits I pick lets me know what I need to do better so, I can improve my sleep" - *Female, 17*
Design	*"[The app being] only black and white so it feels basic. I would like an option with color and no color" - Male, 15*
Areas for improvement	*"The story could have been funnier, maybe if it included some characters from books or movies I watch" - Female, 17*
Habit formation	*"The app would be useful to help someone to have better sleep habits because it helps users keep track of their sleep and has reminders." - Male, 15*
Relevance	*"Yes, very helpful [for someone my age] and gives you chart and shows you things you need to improve." - Female, 17*
Motivation	*"…a lot of teens don't go to sleep at reasonable time, so with this app it can make us wake up at time we're supposed to." - Female, 17*

Table 2. Usability study participant average ratings (n=4)	
Outcome	**Score ($\bar{x}$)**
Ease of interaction	9.50
Ease of finding information	9.50
App organization	9.75
Appropriate content	9.25
Overall satisfaction	**9.25**

Discussion

The usability study findings indicate that the PATH-S prototype app was highly usable, acceptable, and engaging for teens in the intended audience. Overall feedback was positive, with participants describing the app as easy to understand, well organized, and personally relevant. High average ratings across usability topics—including ease of use, navigation, content appropriateness, and overall satisfaction—suggest that the app's design successfully aligned with teen user preferences. These results are especially meaningful because teens are discerning and often critical of digital tools, and may quickly disengage from platforms that feel confusing, generic, or unappealing.[17] The usability study results suggest that the PATH-S app addresses this selectivity by offering a clean, unique, and personalized

content experience.

Participants in the usability study valued the personalized nature of the PATH-S app, including the app's recommendations based on quiz responses and the dashboard that reviewed the week's sleep hours. Personalization may be a key strength of PATH-S because tailored feedback can increase relevance, motivation, and sustained engagement.[18] The app translates user input into actionable insights to help teens better understand their sleep patterns and identify realistic improvements.

The findings from the usability study are consistent with previous studies evaluating mobile health applications designed for teens, which have highlighted the importance of visual design and customization. In a study evaluating an asthma management app, teens generally found the app easy to use but recommended greater customization of features, including charts and notifications.[19] Similarly, usability studies on other health apps found that teens preferred colorful, modern interfaces with visually appealing graphics, personalization, and gamification.[20,21] Consistent with these findings, the PATH-S app usability study participants suggested adding more colors and visually engaging, age-appropriate graphics to improve the app's appearance. These results highlight the importance of incorporating teens' design preferences when developing mobile health applications to promote usability and engagement.

Limitations should be considered when interpreting these findings. While the sample reached saturation in feedback, testing focused on the prototype app, rather than a fully developed app. Therefore, participant reactions may differ from experiences during long-term and real-world use. KDHRC will integrate usability testing participant's feedback into future iterations of the app and will consider long-term methodologies to better understand how teens interact with the PATH-S app over time.

Conclusion

The PATH-S usability study demonstrated that the PATH-S prototype app was well received by participating teens and showed strong potential as a practical digital tool to support healthier sleep habits. Findings from the usability study informed further refinement of the app to better align its design and features with teens' preferences. Following these refinements, KDHRC conducted a feasibility study to examine whether using the PATH-S app was associated with improvements in sleep knowledge, self-efficacy, and sleep duration among teens. Research Brief No. 46 will describe the feasibility study methods and findings, with implications for the program's dissemination and widespread use.

References

1. Shaluhiyah, Z., Qatrannada, S. A., Kusumawati, A., & Miah, M. S. (2025). The effect of digital health intervention in promoting healthy behavior: A systematic scoping review on strategies to prevent non-communicable diseases. *Dialogues in Health*, *7*, 100258. https://doi.org/10.1016/J.DIALOG.2025.100258
2. Boumparis, N., de Riedmatten, P., Champion, K., Cea, G., de Pablo-Pardo, T., Koutra, K., Rizvi, K., Pearce, H., Triantafyllidis, A., Molina-Barceló, A., Schaub, M. P., & Haug, S. (2026). Behavior Change Techniques in Digital Health Interventions for Promoting Adolescent Health Behaviors: Systematic Umbrella Review. *JMIR Mental Health*, *13*, e84754. https://doi.org/10.2196/84754
3. Bommersbach, T. J., Olfson, M., & Rhee, T. G. (2026). Insufficient Sleep Among US Adolescents Across Behavioral Risk Groups. *JAMA*, *335*(13), 1173–1176. https://doi.org/10.1001/JAMA.2026.1417
4. Garey, J., Baker, A., Carskadon, M. A., & Meldrum, R. (2026, June 17). *Sleep Deprivation in Teens*. Child Mind Institute . https://childmind.org/article/happens-teenagers-dont-get-enough-sleep/
5. Teens and sleep: Why you need it and how to get enough. (2008). *Paediatrics & Child Health*,

13(1), 69. https://doi.org/10.1093/PCH/13.1.69
6. National Sleep Foundation. (2024, March 7). *What To Know about Teens and Sleep*. National Sleep Foundation. https://www.thensf.org/what-to-know-about-teens-and-sleep/
7. Uccella, S., Cordani, R., Salfi, F., Gorgoni, M., Scarpelli, S., Gemignani, A., Geoffroy, P. A., De Gennaro, L., Palagini, L., Ferrara, M., & Nobili, L. (2023). Sleep Deprivation and Insomnia in Adolescence: Implications for Mental Health. *Brain Sciences*, *13*(4), 569. https://doi.org/10.3390/BRAINSCI13040569
8. National Heart, L. and B. I. (2022, March 24). *How Sleep Works - Why Is Sleep Important?* https://www.nhlbi.nih.gov/health/sleep/why-sleep-important
9. U.S. Centers for Disease Control and Prevention (CDC). (2024, July 2). *Sleep and Health*. https://www.cdc.gov/physical-activity-education/staying-healthy/sleep.html
10. John Hopkins Medicine. (n.d.). *Teenagers and Sleep: How Much Sleep Is Enough?* Retrieved March 15, 2026, from https://www.hopkinsmedicine.org/health/wellness-and-prevention/teenagers-and-sleep-how-much-sleep-is-enough
11. *Sleep for Teenagers | Sleep Foundation*. (n.d.). Retrieved April 14, 2026, from https://www.sleepfoundation.org/teens-and-sleep
12. Levenson, J. C., Ford, H. A., Reyes, Z. M. D., Mukundan, A., Patel, G., Bahary, S., & Miller, E. (2021). Designing Adolescent Sleep Interventions with Stakeholder Input. *Sleep Health*, *7*(5), 581. https://doi.org/10.1016/J.SLEH.2021.07.007
13. *Teens are sleeping less than ever and screens may not be primarily to blame : NPR*. (n.d.). Retrieved April 14, 2026, from https://www.npr.org/2026/03/08/nx-s1-5737426/time-change-teens-sleep-screens
14. Hale, L., Kirschen, G. W., LeBourgeois, M. K., Gradisar, M., Garrison, M. M., Montgomery-Downs, H., Kirschen, H., McHale, S. M., Chang, A. M., & Buxton, O. M. (2018). Youth screen media habits and sleep: sleep-friendly screen-behavior recommendations for clinicians, educators, and parents. *Child and Adolescent Psychiatric Clinics of North America*, *27*(2), 229. https://doi.org/10.1016/J.CHC.2017.11.014
15. Nielsen, J., & Landauer, T. K. (1993). A Mathematical Model of the Finding of Usability Problems. *Proceedings of ACM INTERCHI '93 Conference*, 206–213. https://dl.acm.org/doi/pdf/10.1145/169059.169166
16. Nielsen, J. (2000). *Why You Only Need to Test with 5 Users*. NNgroup.
17. Reen, G. K., Muirhead, L., & Langdon, D. W. (2019). Usability of Health Information Websites Designed for Adolescents: Systematic Review, Neurodevelopmental Model, and Design Brief. *Journal of Medical Internet Research*, *21*(4), e11584. https://doi.org/10.2196/11584
18. Rouvere, J., Griffith Fillipo, I. R., Romanelli, M., Sharma, A., Mosser, B. A., Nguyen, T., Rushton, K., Marion, J., Althoff, T., & Pullmann, M. D. (2025). Personalization Strategies for Increasing Engagement With Digital Mental Health Resources: Sequential Multiple Assignment Randomized Trial. *JMIR Mental Health*, *12*, e73188. https://doi.org/10.2196/73188
19. Sage, A., Roberts, C., Geryk, L., Sleath, B., Tate, D., & Carpenter, D. (2017). A self-regulation theory-based asthma management mobile app for adolescents: A usability assessment. *JMIR Human Factors*, *4*(1), e7133. https://doi.org/10.2196/humanfactors.7133
20. Bosworth, K. T., Flowers, L., Proffitt, R., Ghosh, P., Koopman, R. J., Wilson, G., Tosh, A. K., & Braddock, A. S. (2023). Mixed-methods study of development and design needs for CommitFit, an adolescent mHealth App. *mHealth*, *9*, 22. https://doi.org/10.21037/MHEALTH-22-35/COIF
21. Truman, E., & Elliott, C. (2022). Testing a Mobile App for Participatory Research to Identify Teen-Targeted Food Marketing: Mixed Methods Study. *JMIR Formative Research*, *6*(5), e35886. https://doi.org/10.2196/35886

Acknowledgements

This research was self-funded.

DIVYA M. MATHEW, MPH is a Research Assistant at KDH Research & Communication

ALYSSA R. JACKSON, MEd is a Research Associate at KDH Research & Communication

ADAM J. BOIMAN, MS, MPH is a Research Assistant at KDH Research & Communication

ELIZABETH R. PHELPS is a Research Associate at KDH Research & Communication

MORGAN L. FLEMING, MPH is a Senior Account Manager at KDH Research & Communication

KRISTEN D. HOLTZ, PhD is the Founder and President at KDH Research & Communication

KDH RESEARCH & COMMUNICATION

145 15th Street NE
Suite 831
Atlanta, GA 30309

www.kdhrc.com
publicaffairs@kdhrc.com

KDH RESEARCH & COMMUNICATION is a non-partisan, public health, research and communications agency. The goal of the "Informing Public Health" brief series is to disseminate innovative, objective, and timely information to solve public health and other social issues. KDHRC actively contributes to a future when all people can find, understand, and act on information to safeguard the health of themselves, their families, and their communities.

The views expressed here are those of the authors and do not necessarily reflect those of KDH Research & Communication, its board, or funders. Permission is granted for reproduction of this document with attribution to KDH Research & Communication.