Exploring needs, interests and preferences for digital mind-body tools for adolescents

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Abstract

Sleep problems are common among adolescents and research on mind-body interventions for sleep is promising. Although technology-based mind-body interventions have been shown to help early adolescents with practicing mind-body approaches, engagement and adherence has been a challenge. Using a Human-Centered Design framework with semi-structured interviews with parent-adolescent dyads, we describe exposure to, interest in, and preferences for digital mind-body technology for sleep. Identified challenges (e.g., 'establish routine', 'busy schedule) and preferences (e.g., age-appropriate content) reflect mind-body technology needs that impact engagement. Based on these findings, we recommend that a technology-based mind-body approach for early adolescents be designed to 1) provide content customized for adolescents 2) include functionalities that engage adolescents like games and rewards, and 3) allow for granular sharing controls. These recommendations provide a foundation for designing digital mind-body tools for adolescents.

Introduction

The American Academy of Pediatrics recommends 8-10 hours of sleep for children ages 13-18 and 9-12 hours of sleep for children ages 6-12 for optimal health. Yet 58% of middle school students and 73% of high school students do not get enough sleep.[1] A study published in 2019 found that only 5% of US adolescents meet recommendations for sleep, physical activity, and screen time concurrently.[2] Moreover, due to the COVID-19 pandemic sleep problems in adults and children has exacerbated. A systematic review shows that the pooled prevalence in sleep disturbances during the pandemic among children was more than two times the prevalence reported before the pandemic.[3] Lack of sleep and poor sleep can lead to many health concerns in adolescents. For example, sleep disturbance in childhood is known to lead to both short-term and long-term health consequences like obesity, depression, and substance use.[4] Hence there is an increasing need for interventions that target sleep health in adolescents.

Research on use of mind-body interventions for sleep is promising. Mind-body approaches are techniques that focus on the interactions between mind, body and behavior. They include a large and diverse group of procedures and techniques. Examples include yoga, acupuncture, tai chi, breathing exercises, meditation, and biofeedback. These approaches have been shown to help treat or self-manage various conditions like chronic pain, headache, anxiety, and stress as well as sleep in children and adolescents.[5–8] Systematic reviews show that mind-body approaches can help improve sleep outcomes including sleep quality, sleep onset latency, and sleep efficiency in adolescents.[9–11] Many existing mind-body approaches for adolescents have been delivered in person[12], in group settings[9], or at schools.[10,11] However, in-person sessions may be infeasible for many adolescents, due to busy schedules, dependence on adults for driving to in-person sessions, and high cost. Moreover, the goal of mind-body approaches is for adolescents to learn the skills and incorporate them in their daily life. Thus, a technology-based approach can make mind-body interventions readily accessible and scalable.[13,14]

Research exploring technology-based mind-body interventions in adolescents shows promise.[9,15] Lahtinen et al studied the effect of a digital app-based mindfulness-based intervention and demonstrated efficacy in reducing anxiety and depression in adolescents.[16] However, research with technology-based mind-body interventions in adolescents has shown poor engagement and adherence.[9,17–20] In an online mindfulness-based intervention for adolescents, only 15 out of 95 (i.e., 16%) logged into the online module out of which only 1 person completed the entire mindfulness session.[20] A review of mobile mindfulness-based apps for children found that 50% of apps had "inadequate" or "poor" ratings for engagement (defined as how fun, interesting, customizable, interactive and fun the apps are for children).[19] Research indicates that a combination of factors influence individual engagement with digital tools including personal factors (their knowledge, interest, attitudes etc.), intrapersonal factors (peers, family), technology-related factors (e.g., usability).[21] Thus, in addition to understanding the technology-related factors that adolescents will prefer and use we

also need to understand personal factors (i.e., adolescents' prior experience, their interest in using digital mind-body tools) and interpersonal factors (adolescents' preferences for sharing/using mind-body tools with parents) that play a role in adolescents engagement with digital tools. Given the promise of mind-body approaches for adolescents, there have been calls to engage adolescents to understand their needs, interests and preferences in mind-body technologies.[23] This study seeks to address this gap using the principles of human-centered design.

Human-Centered Design (HCD) is a methodological approach that emphasizes participation of technology users in the design process.[22] The approach involves a multi-stage iterative problem-solving process in which the needs, desires and limitations of users are inquired and analyzed. One of the first steps in the HCD process is 'understanding and specifying the context of use' including characteristics of users, their tasks and the environment in which the tool is used. This informs 'user requirements' that the tool must support to meet users' needs. Based on these requirements we then build prototypes, which we test with users to evaluate against the requirements, iterating to earlier phases as needed. HCD helps ensure that the developed tool will be engaging, acceptable, usable, and meet the needs of users. Currently, there is lack of research utilizing HCD in the design of mind-body technologies for adolescents.

Using HCD as a methodological framework the objective of this study is to explore needs, interests and preferences for digital mind-body tools for adolescents. We focused on early adolescence (ages 10-14) in this study because during this stage of adolescence most children are still dependent on their parents for many aspects of their life yet are slowly learning and gaining independence over media use and sleep. The support of parents and peers can have an impact on adolescent engagement with technology.[14] In this study we interview parents and early adolescents to understand both their perspectives on mind-body technologies for adolescents. We focus on five common mind-body approaches: meditation, relaxation, yoga, art therapy, and music therapy. We chose these approaches based on three criteria that we derived based on existing literature [24] namely 1) adolescents should be able to practice the approach on their own at home; 2) the approach should not require any kind of specialized equipment; and 3) the approach should not involve any special setting/movements/postures (e.g., Tai chi).

The purpose of the study is to explore needs, interests and preferences for digital mind-body tools for adolescents. Our study seeks to address the following research questions: 1) What are parents' and adolescents' current exposure to mind-body approaches, 2) What are potential challenges adolescents face in learning mind-body approaches, and 3) What are parents' and adolescents' interest and preferences in using technology for learning and practicing these approaches for better sleep.

Methods

We conducted individual surveys and semi-structured interviews with parent-adolescent dyads. Study procedures were approved by University of Washington Institutional Review Board.

Recruitment: We recruited parent-adolescent dyads. The inclusion criteria for adolescents to participate in the study were being 10-14 years of age, speaking and reading primarily in English, and adolescents reporting more than one hour of technology usage during the three hours before going to bed. Participation was limited to one child per family. COVID-19 restrictions led to fully web-based recruitment and data collection between January 2021 to May 2021. We recruited a convenience sample by posting flyers to social networks (i.e., Facebook) and professional networks (i.e., listservs). To improve the response to recruitment, we added snowball sampling (i.e., asking participants to recommend new participants). We analyzed data concurrent with data collection and recruited participants until saturation was reached.[25] Interested parents were invited to contact the study team after screening for consent and study enrollment

Data Collection: We emailed parents both the parent and the adolescent online surveys and after completion of survey we scheduled one-on-one virtual interviews via Zoom. Survey questions included demographics, technology use and sleep patterns in adolescents. We conducted semi-structured interviews with the parent and adolescent separately to allow for free expression regarding their perspective on mind-body approaches. Each interview lasted between 30-40 minutes. Both the adolescent and parent's interview guide included questions guided by the study objectives including their exposure to mind-body approaches, challenges in learning these approaches, and interest in using technology to learn mind-body approaches.

Data Analysis: We transcribed verbatim all audio-recorded interviews. We deductively coded the data with a high level a priori coding schema[26] based on our interview guide: Parent exposure to mind-body approaches, adolescent exposure to mind-body approaches, challenges in adolescent learning these approaches, interest in adolescent learning

mind-body approaches and learning mind-body approaches digitally. The first author analyzed the transcripts using the coding schema in Dedoose.[27] The authors discussed the codes collaboratively and refined the codebook as needed. The second author coded a random selection of excerpts (20% of the data) to assess reliability (Cohen's K = 0.98).

Results

1. Demographics

22 participants completed the study, including 11 adolescents (C1-C11) and 11 parents (P1-P11) (Table 1). The sample was predominantly white and non-Hispanic. Parents were female and college educated or greater. More adolescents were male. Mothers ranged in age from 35-58 (Mean=45, SD =7), and adolescent ranged in age from 10-14 (Mean=12, SD=2).

All mothers reported using laptops, smartphones and televisions. These were the most commonly used devices reported by parents, while most adolescent (9/11) reported using laptops, televisions, and smart speakers. Both parents and adolescent reported their bedtime as after 9 pm with some adolescent reporting going to bed past 10:30 (3/11). And 36% of adolescent (4/11) reported a sleep onset (time taken to fall asleep) > 15 minutes.

Table 1. Participants	Parents n=11 (%)	Adolescent n=11 (%)
Sex		
Male	-	7 (64%)
Female	12 (100%)	3 (25%
Other	-	1 (9%)
Race		
White	8 (73%)	8 (73%)
Asian	2 (18%)	2 (18%)
Other	1 (9)	1 (9%)
Ethnicity		
Hispanic/Latino	2 (18%)	3 (27%)
Not Hispanic/Latino	9 (82%)	7 (64%)
Decline to state	-	1 (9%)
Education		
High school degree	-	
College degree	6 (55%)	
Advanced degree	3 (27%)	
Doctorate degree	2 (18%)	

2. Exposure to Mind-Body Approaches

Overall, all parents (11/11) had heard about at least one of the 5 mind-body approaches (i.e., meditation, relaxation, yoga, art therapy and music therapy) and most parents (10/11) had either practiced at least one of these techniques in the past or were currently practicing them. Parents described several reasons for starting to practice these techniques primarily being pregnancy, stress, and the COVID-19 pandemic. Some parents also described using technology to practice these techniques for example, parent P3 shared:

> "So I use the Calm app in particular during Covid I had a really hard time sleeping in large part, because we would have meetings on till nine or 10 at night.Or we would be running trials with people in the east coast, so that meetings will start at four in the morning and so my sleep wake schedule was even worse than it typically is. And so I bought the Calm app then and really helped me to turn off at night when I would go straight from a meeting until 10pm to like 'oh my God, I need to go to bed, because I have to be up at four'. And so that was really great."

Like parents, most adolescents (10/11) had heard about at least one of the 5 approaches and some adolescents (5/11) had either practiced these approaches in the past or were currently practicing them. Adolescents had learned mind-body approaches either from their parents or through school (teachers or counselors). For example, adolescent C11 described:

> "It was mostly in like middle school so like my social studies teacher will have like a video on that like talks about like meditation like doing it like we do that before tests and then in the seventh grade we would also do like in start of class."

In addition to learning these approaches in person some of the adolescents also described utilizing technology to learn about these approaches as well, as stated by adolescent C7:

> "Well, one time me and my mom did this peloton meditation before bed."

Among adolescents who practiced these approaches some adolescents really like doing meditation as C2 described:

"Oh they're [meditation] really good they're really nice and calming for when I go to sleep sometimes, I'll fall accidentally fall asleep, while listening to it, but its overall just really nice. It gets rid of my stress easily because I get stressed out because of school and my anxiety and it's just really easy for me just to let that all go."

3. Challenges adolescents face in learning mind-body approaches

Although participants expressed interest in mind-body approaches for sleep, both parents and the adolescent described many challenges adolescents have/will have in learning and practicing these approaches routinely. Challenges parents mentioned include lack of time, remembering to do it, and the adolescent prioritizing other interests. For example, parent P3 shared:

"It's more of like the choice of what she [their child] does before bed. I think that the 10 minute meditation or the 10 minute app it's not that they push back on the app it's that it's in place of something else, they want to do at nighttime because I think it's the last thing you do until the day is over, you know that's the pushback at night."

Parents also indicated that the length of time to practice the session was also a challenge and adolescents would be more open to doing the mind-body approach if it was shorter rather than an hour-long session. Parent P6 shared:

"Yeah actually that's [mind-body approach] a good idea.I don't know how long the session will be, but if it is like a one-hour session, it might be challenging for them [adolescent], but if they are just you know asked to do 10 minutes every day and that might be useful for them definitely."

Parents also felt that showing adolescents the benefits of doing mind-body approaches was a big challenge. As parent P10 shared:

"So probably the biggest challenge is showing him the benefits of it and convincing him that it was worth his time and effort."

Adolescents also described challenges with practicing meditation like "*finding it hard to focus*" (C3), "*sitting still*" (C14), having "*patience*" (C12), and finding it "*boring*" (C13). As adolescent C11 described:

"Yeah, so for meditation a lot of times, people say like think of nothing but I, I kind of have a hard time with that like whenever we're meditating I'm like thinking through all the things that we have to do during the day."

Adolescents also described lack of interest or prioritizing other interests (e.g., sports) as another reason for not practicing these approaches. For example, Adolescent C10 shared:

"I just rather do other things like I'd rather go play some sports or go talk to my friends."

4. Interest in learning mind-body approaches digitally

Both parents and adolescents were very supportive of adolescents learning these approaches for better sleep. Parents compared learning mind-body approaches to life skills like learning a language or swimming or brushing teeth. For example, Parent P5 stated:

"So I would totally be in favor of people learning this because it's a life skill that's going to help them for the rest of their life it's like, why do we teach people swimming like that, if you're able to teach this yoga and meditation soon enough that is going to help them in the long run."

Many adolescents were also supportive of the idea of adolescents their age learning these approaches. Adolescent C3 described:

"I think it's good to learn meditation because that's one thing that could help you with like calming down or like falling asleep, or it can also help it can also work as a coping method."

Similarly, adolescent C8 described:

"I think it's good I mean you know if you're in a stressful situation you can you know kind of just get peace of mind for even for a few moments if you think I think it would be nice."

Parents and adolescents were also very supportive of the idea of adolescents learning mind-body approaches digitally. As parent P6 described:

"I think like if it [mind-body approach] is digital, they'll give it a try they learn it and maybe if they are teaching them for like 30 minutes at least 10 minutes they'll focus and learn something."

Similarly, adolescent C11 described:

"I think it's like really great like I've heard of like Apps that have stuff like that help people with like meditation and relaxing I think that's really great. Like I think technologies are very good way to keep people to do it. And, like the videos can like help a lot like just to get your mind off of things and it's like always it's a different experience doing it through technology than like in person."

Adolescents also indicated that technology provided the flexibility to learn at their own pace. Adolescent C7 described:

"Similar to school I feel like it's how because you know, when it comes to like help videos you don't have to watch it with the teacher, you can just watch it by yourself, or like when you're doing your work, you can just mute your video and your mic and you can just work by yourself, instead of having to consistently be contributing to the conversation."

Parents and adolescents both felt that the chances of the adolescent trying and practicing mind-body approaches are higher if it is incorporated into their lives and spaces that they are already familiar with. For example, adolescent C14 suggested incorporating mind-body approaches into Instagram.

Moreover, parent P8 suggested that having their child's friend or his school counselor use a mind-body app with the child first before they try it on their own could be beneficial:

"I mean, he likes having his friends on if there was a way to wrap that into a meditation APP I don't know if his friends would go for it. Or if like his school counselor had used an APP with him. I think he would be more likely to continue that at home. If he had had some success with it, you know kind of guided live through it first."

Even though parents and adolescents were very supportive of using technology to learn these approaches they also described some challenges when using technology to learn these approaches like not having the same experience as in person. As adolescent C7 described:

"One thing I didn't like [about the digital mind-body approach], though, is that, throughout the whole time she [the digital instructor] was talking and talking and then was kind of preventing me from actually like meditating because every time I would like, open an eye just to see what she was talking about."

5. Preferences for digital mind-body tools

Parents and adolescent described their preferences for digital mind-body tools for adolescents that we grouped into three areas namely content, functionality and sharing.

Content: Parents and adolescents indicated their preferences on the content of mind-body technology to engage adolescents, including ensuring content is age-appropriate, providing a variety of content to choose from, and receiving feedback.

Parents and adolescents shared that they preferred mind-body approaches that were tailored to their age group. One potential way suggested found in a popular app that one family had tried was utilizing stories or structuring the mind-body approach around a storyline:

"I like it more because they [the app] have like kind of like a storyline that they listen to and then they're like somebody asks you to like imagine what you see in the storyline." (adolescent C3)

"Because they're [app]much more story-based they're sort of like a really boring fairy tale or very repetitive, and so I think the kids like that a little bit better. But I find if they watch something even if it's the same thing, like with clouds going by and they just they don't fall asleep, in the same way." (parent P3)

Another parent, P11, described the need to ensure the content is age-appropriate:

"I think for him the apps that I tried to have him do before he felt like were geared towards kids that were too young. So, maybe some of the ones that are actually geared towards you know more adults would actually work

better for him. Because I think that's part of why he didn't stay engaged with those other apps. They were probably geared towards like you know, maybe eight year old's or 10 year old's."

Parents and adolescents mentioned that learning via technology provides the flexibility to access teachings from different instructors, including those matching individual preferences and flexibility to join group vs private sessions:

"Because like people everybody teaches it in different ways, like that can be reflected through technology, so you can learn a bunch of different ways, instead of having like the same person teaching it to you, over and over again." (adolescent C11)

Parent participants also indicated that having virtual group sessions or classes where the adolescent were part of group instruction with adolescents their age can help their adolescents learn and engage with the session. However, parents also pointed out that having a group session would also need to be monitored:

"Instead of us asking them [adolescent] to watch a YouTube video and sit in front of TV and do yoga it's better you know if it is like a group instruction and all kids are doing it, they will try to the do it." (parent P6)

"I think one thing that he really likes is interaction with people and if there was an app that had maybe like a live class type of thing I wonder if he would be more open to using it and I would definitely have to monitor that because you know I don't necessarily know the person, but if it's through a company a reputable company then I'm probably more likely to trust.. trust it." (parent P8)

Adolescents and parents indicated that receiving feedback on if the way they were performing the approach correctly was challenging when learning mind-body approaches digitally. As adolescent C6 described:

"It [technology] was a little harder because in person they can show you how to do, and like make you do, but online you just have to like follow it and keep on doing it until you get it."

Similarly, parent P13 described:

"It's harder to do it on your own if you are a complete newbie and don't have a lot of experience or other experienced people around you to tell whether you're doing it correct or incorrect or are just winging it kind of."

Functionality: Parents and adolescents also shared specific functionalities, like rewards and reminders, that can help engage adolescents with technology-based mind-body approach.

Many parents and adolescents indicated that most adolescents will be interested in the reward or benefit of doing the approach and they also provided some ideas on how the rewards can be structured like winning coins, prizes like stickers or toys. Parent P9 described adding the mind-body approach to something the adolescent already like to use:

"If you could attach the app to one of the apps they [adolescents] wanted to use, and they would have to use play for five minutes before they could get access to another app I've never heard of an app that does that, but why couldn't it. You know, like it was a password to get into another app was to do you're meditating although you couldn't actually make them meditate, could encourage them to say, well, you can't do your app for five minutes, so you might as well just sit and think about nothing."

Adolescent C7 also described maybe having access to a puzzle as a reward for completing the mind-body approach:

"Maybe like something to build upon like maybe like a picture for like each meditating each meditation class when you go back to the next one, you earn that other piece of the picture, or something or like a figurine or something like you earn another piece of the figurine."

Adolescents also described having games as part of the digital mind-body approach could also motivate adolescents their age learn these approaches:

"I think it'd be kind of cool if, like there was like do like five or 10 minutes of meditation and you can play this like almost exclusive game that you have to meditate for… And you can play that or like as a selection of games as like exclusive to that exercise I think that'd be for people who like to play games like me I think that'd be interesting incentive okay."(adolescent C8)

"Maybe like a game section like if you do like a certain my yoga you can like play like a game for a few minutes and then can like motivate kids to like want to do it." (adolescent C4)

Adolescents also suggested that having a digital approach can help with setting reminders and notifications to perform the approach daily.

"It could be like a calendar on the app to like Remind you to do it there could be notifications to like yoga in five minutes or something."(adolescent C4)

"I feel like doing it without the technology would be a little struggle…it's easier, with my phone because I'll have a reminder saying, make sure you remember to listen to this and it will be easier." (adolescent C2)

Parents and adolescents also indicated that while practicing mind-body approaches via technology the possibility of being distracted was higher and so limiting distractions was key. Adolescent C3 indicated:

"I like the apps a little bit more because, like they're not like they're not all on video so it's a lot easier for me not to get distracted."

<u>Sharing</u>

Parents and adolescents expressed mixed interest in sharing information regarding the digital mind-body technology, co-using and/or sharing progress from digital mind-body-based technology with others, such as parents and friends.

The parents were very supportive of using digital mind-body technology along with their adolescents and wanted to observe, participate and even try out some of the approaches. Parents were concerned about privacy of their adolescents particularly in group sessions. Some parents were not sure if their adolescents would want them to co-use a digital tool. As parent P9 described:

"I think it would be fun to have some encouragement inside something like that, for some of the time to be with other family members or even other friends. But I wouldn't want it to be contingent."

Some adolescents were comfortable co-using the technology with their parents and sharing information regarding their use of the technology with their parents while others didn't feel comfortable sharing. As adolescent C9 stated:

"I feel like it'd be a little weird to have them [parents] there because, like, I feel like just the practice of, the… yeah just the practice of doing it would make me feel awkward and if I had my parents like they're doing it, I think I just would kind of want to stop doing it."

When adolescents were asked if they would share information about their use of mind-body technologies with friends, we received mixed interest. Most adolescents showed guarded interest in sharing information with friends. One adolescent indicated that they would share the information with their friends only if the technology was interactive and didn't feel like a personal "*going to a therapist*" (C12) session.

A few adolescents also indicated that they would only share this information on mind-body approaches when their friends ask for it or indicate that they need help. For example, adolescent C10 indicated:

"I'm Like. Maybe, I won't just like bring up like oh look at this app like if they were asking me like i'm just having like trouble doing this thing and then I would probably like share with them like this is what I do."

Some adolescents were only interested in sharing information on the approach broadly without providing any details on their own status or progress with the approach. For example, adolescent C7 indicated:

"I would probably share the app I wouldn't share my progress, because just based on the way that kids are nowadays, they're probably not going to care at all, I mean maybe they'll be intrigued in the app, but I don't think they'll care about my progress."

Hesitation to share information regarding mind-body approaches with peers could be due to potential stigma associated with practicing these approaches. During interviews, all the parents openly shared their history of practicing these approaches, while many adolescents were hesitant about such sharing. Some adolescents shared that they associated practicing these approaches with therapy. Some example quotes include: "*I wouldn't call it therapy because that kind*

of makes it sounds weird to kids."(C9), "*it shouldn't feel like a personal like I'm going to therapist.*"(C12), " *I wouldn't just like just bring it up like I guess I wouldn't really talk about it like that.*"(C10)

Discussion

Guided by HCD principle we directly engage adolescents to understand their perspectives on learning mind-body approaches for sleep and using technology to learn these approaches We identify interests and preferences adolescents have in learning and practicing mind-body approaches. Overall, most parents and adolescents had some exposure to mind-body approaches and were enthusiastic about adolescents learning mind-body approaches to develop better sleep habits. When designing technology for mind-body approaches for adolescents it is valuable to consider features that reduce barriers (e.g., '*establish routine', 'busy schedule', 'sitting still', 'boring'*) and enhance the motivators for adolescents e.g., showing them the benefits. These findings contribute insight into the potential use of technology-based mind-body approach among adolescents to develop better sleep habits.

Our findings, based on perspectives of parents as well as adolescents, carry implications for the design of digital mind-body technology to address inadequate sleep among adolescents. First, parents and adolescent participants preferred mind-body approaches that are tailored to engage adolescents with customized content that includes age-appropriate materials, feedback to support learning and variety of teachings etc. This finding is consistent with prior research indicating that mindfulness interventions for children should have simple instructions, short activities and rely on metaphors and images that children can relate to.[28] Similarly, the lack of feedback to support learning in existing digital mindfulness systems had also been documented.[29,30] Yet there is lack of research focused on understanding acceptable and effective adaptation of content of mind-body approaches for adolescents in the technology space. Additional work with adolescents is needed to understand further their preferences for effective adaptations of mind-body approaches.

Second, parents and adolescent participants felt that to attract and engage adolescents in the mind-body approaches incorporating functionalities like gamification (e.g., games, badges, rewards) could help. This result expands on previous research with adolescents for other health issues like physical activity and nutrition[31,32] where gamification features like games, rewards, badges have shown to increase engagement and sustain technology use. However, the findings of this study contrast with findings by Lukoff et al (2020) whose work with mindfulness teachers/experts emphasize that addition of gamification to mindfulness apps undermined the tenets of mindfulness (i.e., mindfulness practice is not achievement-oriented but process-oriented). They recommend that when designing mindfulness tools to strive for coherence with underlying principles of mindfulness while exploring features of technologies. Future work is needed to explore these tensions and align interests of adolescents in engagement with mind-body technologies.

Finally, our findings indicate that adolescents are guarded in sharing information about their use of mind-body approaches or progress in performing these approaches with peers. Adolescents might experience stigma associated with these approaches. Previous research shows stigma associated with children for seeking help for mental health issues.[33] Yet research investigating stigma around mind-body approaches among adolescents is lacking. It is possible that adolescents relate learning mind-body approaches to stigmatizing 'therapy' and hence were apprehensive about sharing information with friends. Yet sharing health information with social networks or peers for comparison is a common feature supported by many mindfulness-based apps.[19,34] Prior research with adolescents shows that social support and input from parents, healthcare providers, and peers who engage in shared co-use via technology can help empower adolescents in self-management of overweight and obesity.[35] However, stigma associated with mind-body approaches could impact use of sharing features. Future research should further explore these issues to understand how to effectively engage parents and other stakeholders in the use of mind-body technology to support adolescents.

Based on our findings we recommend that a technology-based mind-body approach for adolescents be designed to: 1) provide content that is customized for adolescents, 2) include functionalities that engage adolescents like games and rewards, 3) and allow for granular sharing controls i.e., control over what information is shared and with whom. Our results suggest that a well-designed mind-body technology could potentially increase accessibility of mind-body approaches for adolescents and support better sleep for adolescents thus enhancing their wellbeing. Facilitating engagement in digital technologies is multifaceted and complex and involves a combination of personal, interpersonal and technology-related factors.[21] When designing technology for adolescent care needs to be taken to match these factors to design features that adolescents prefer and most likely engage with. For example, our results indicate that adolescents were guarded in sharing information regarding mind-body approaches with peers, even though sharing personal health information has been shown to be of interest in adolescents with diabetes.[36] Our findings offer a first step by offering guidance for design of mind-body technologies for adolescents.

Our findings provide a foundation for designing digital mind-body tools for adolescents. Yet, they should be evaluated in the context of some limitations. Our sample of parents and adolescents was primarily white and non-Hispanic/Latino. Parents were mothers with college or graduate degrees. Future research is needed with additional demographic groups to understand whether the study results extend to other groups. Future research should include adolescents with sleep problems to understand further their motivations for using mind-body technology. In an effort to understand broader implications for mind-body approaches for adolescent sleep, we did not focus on a specific interactive system however it is important to note that participants often referred to their use of mobile apps and YouTube videos when describing how they were exposed to mind-body approaches. Additional work is needed to understand and account for family technology practices. Future work should also evaluate the feasibility and effectiveness of digital mind-body tools for adolescents. Despite these limitations, this study has several strengths, including utilizing a HCD approach that directly engaged adolescents and parents via semi-structured interviews to obtain their detailed perspectives on digital mind-body tools for adolescents.

Conclusion

Given that sleep problems are increasing in adolescents and the need for mind-body interventions for adolescents, but the lack of existing guidance in designing digital mind-body tools for adolescents, our findings fill a gap in better understanding the perspectives of parents and adolescents. We describe exposure to, interest in, and preferences for digital mind-body technology for adolescents. Parents and adolescents expressed interest in using mind-body technology and expressed preferences for design of features for content, functionality and sharing. Mind-body technology that are designed to meet these needs and preferences have the potential to enhance engagement by facilitating accessible, convenient and scalable interventions for improving sleep among adolescents. Future work should explore the transferability of these findings in a larger group of participants.

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