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# A Pilot Study of a Cognitive–Behavioral Sleep Intervention Specifically for Adolescents With ADHD and Sleep Problems: A Qualitative and Quantitative Evaluation

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*The current pilot study evaluates a cognitive behavioral (CBT) sleep intervention specifically developed for adolescents with ADHD – Sleep IntervEntion as Symptom Treatment for ADHD (SIESTA). Based on a qualitative and quantitative evaluation, the final aim is to fine-tune SIESTA and the assessment protocol to the target population. Eight adolescents (13–17 years old) with ADHD and sleep problems completed SIESTA. Separate focus groups with adolescents and parents were conducted to evaluate their experience with SIESTA and the assessment protocol. These were analyzed using thematic analysis. Additionally, individual reliable change indices were computed from pretest to posttest for sleep hygiene practices. Thematic analysis showed that adolescents and parents reported both positive aspects and points of improvement of SIESTA and the assessment protocol during the focus groups. Reliable change indices showed that all adolescents significantly improved on at least one of the subscales of the revised Adolescent Sleep Hygiene Scale. Preliminary qualitative findings indicate satisfaction with SIESTA and the assessment protocol, with some suggestions for further improvements, and quantitative findings indicate significant improvement in sleep hygiene. The next step is to test the effectiveness of SIESTA in a randomized controlled trial, based on the adaptations after this pilot study.*

Research shows that up to 72% of adolescents with ADHD experience sleep problems (Langberg et al., 2017). They sleep less, need more time to fall asleep, wake up more often after sleep onset, experience more sleepiness during the day and report more nonrestorative or restless sleep, compared to adolescents without ADHD (Marten et al., 2023). These sleep problems and more specifically shortened sleep duration were found to be causally related to an increase in inattention, hyperactivity-impulsivity and oppositionality symptoms in adolescents with ADHD (Becker et al., 2019).

Several factors have been suggested to underlie these sleep problems in adolescents with ADHD. First, ADHD is biologically associated with later bedtimes, which can result in insufficient sleep due to the necessary early rise times for school (Coogan & McGowan, 2017). Second, academic difficulties often seen in adolescents with ADHD might contribute to daytime sleepiness (Langberg et al., 2016). Factors such as procrastinating, inefficient studying, and poor time-management at the beginning of the school year predicted more daytime sleepiness at the end of it, even when controlling for ADHD symptoms (Langberg et al., 2016). This relation is suggested to be mediated by academic pressure, stress, worrying, anxiety, or feelings of failure (Langberg et al., 2016). Third, although the direction of effects is not conclusive, stimulant medication as the predominant treatment for a large percentage of adolescents with ADHD may affect sleep (Wiggs et al., 2023). Last, adolescents with ADHD may show more inadequate sleep hygiene practices compared to adolescents without ADHD (e.g., Bourchtein et al., 2019; Cusick et al., 2020), with these practices playing a considerable role in sleep problems (Martin et al., 2020).

Sleep hygiene entails sleep practices (e.g., bedtime routine), the sleep environment (e.g., temperature of the bedroom), scheduling (e.g., consistent sleep and wake times), and physiological factors (e.g., caffeine

*Keywords:* sleep; adolescence; ADHD; CBT



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use) that may affect sleep (Martin et al., 2020). Various inadequate sleep hygiene practices, including caffeine use (Cusick et al., 2020), media use (Bourchtein et al., 2019), gaming (Frölich et al., 2009), and variable sleep/wake patterns (Langberg et al., 2019), are more prevalent in adolescents with ADHD compared to adolescents without ADHD, and have a negative effect on self- and parent-reported sleep. More specifically, research shows that in adolescents with ADHD, inadequate sleep hygiene practices are related to self- and parent-reported sleep problems, difficulty falling asleep and reinitiating sleep, difficulty returning to wakefulness, and daytime sleepiness (Martin et al., 2020). Therefore, improving sleep hygiene is a likely sleep intervention target.

To our knowledge, only one study explored the effects of a cognitive behavioral sleep intervention for adolescents with ADHD. The existing cognitive behavioral treatment (CBT), Transdiagnostic Sleep and Circadian Intervention for Youth (TranS-C-Youth) (Harvey, 2016) was piloted (pre-post-follow-up within group design) in 14 adolescents with ADHD and sleep problems (Becker, Duraccio, et al., 2021). TranS-C-Youth uses principles from three evidence-based interventions (Harvey, 2016), namely CBT for insomnia, interventions for delayed sleep phase type, and interpersonal and social rhythms therapy (Harvey, 2016). The intervention consists of multiple modules that are individually tailored to the sleep needs and problems of the adolescent. Results indicated that adolescents showed improvements in sleep, mental health symptoms, and daily life executive functioning, which were maintained at 3-month follow-up (Becker, Duraccio, et al., 2021). However, the sample may not be a representation of all adolescents with ADHD as family income was relatively high, participants were allowed to take melatonin, and participants were highly motivated. Furthermore, TranS-C-Youth is not tailored to the specific needs of adolescents with ADHD.

Although the pilot findings of TranS-C-Youth seem promising for highly motivated adolescents with ADHD and sleep problems, in a more diverse ADHD group it might be necessary to treat sleep problems together with the mental health disorder they co-occur with, as these are interactive and bidirectionally related to each other (American Psychiatric Association, 2013; Becker et al., 2015; Van Dyk et al., 2019). Moreover, tailoring sleep interventions to the specific needs of adolescents with ADHD and sleep problems has been recommended (Cortese et al., 2013).

The first factor to take into account when tailoring a sleep intervention towards adolescents with ADHD is motivation. Intervention dropout rates for youth mental health care are high, with 28% up to 75% of adolescents dropping out of interventions (de Haan et al., 2013). One of the strongest predictors is having an ADHD diagnosis (Johnson et al., 2008). This could be due to problems with intrinsic motivation among youth (Smith et al., 2020). Consequently, motivational interviewing should be integrated in sleep interventions for adolescents with ADHD (Becker & Langberg, 2017) to reduce dropout.

A second relevant factor is planning and organization; adolescents with ADHD have more difficulties with planning and organization (Boyer et al., 2018), resisting immediate temptations (Shoham et al., 2016), and time-estimation (Sonuga-Barke et al., 2010) compared to adolescents without ADHD. All these factors are likely to affect sleep. Due to planning and organization difficulties, adolescents with ADHD may start homework later, leading to later bedtimes (Langberg et al., 2017). Furthermore, adolescents with ADHD are at an increased risk for daytime sleepiness and falling asleep in class (Becker et al., 2019), possibly leading to more self-study after school (Boyer et al., 2018). Moreover, temptations such as media use and gaming, instead of sleeping, are difficult to resist in the evening (Shoham et al., 2016). Their experienced difficulty with timing and time-estimation further increases those difficulties (Sonuga-Barke et al., 2010). Consequently, improving planning is likely to be a beneficial target (Boyer et al., 2015; Maskevich et al., 2021).

A third relevant factor is parental involvement. During adolescence, the need for independence increases, and there is a shift in control from the parents to the adolescents (Christie & Viner, 2005). Thus an approach focusing on the adolescent is needed (Evans et al., 2019). However, parent involvement can still be necessary. A longitudinal study looking at sleep self-regulation shows that adolescents (not an ADHD population) may require support during the transition from parent-controlled to autonomous sleep self-regulation (Maskevich et al., 2021). Specifically for adolescents with ADHD, due to difficulties with self-regulation, they often rely more on parents to regulate their (sleep) behavior, but this can also be a source of increased conflict between parents and adolescents (Hulsbosch et al., 2020). Hence, parent involvement and discussing the balance between controlling and letting go is likely indicated in interventions for adolescents with ADHD (Sibley et al., 2016).

In sum, adolescents with ADHD often experience sleep problems, related to a number of negative outcomes. The present study is the first to qualitatively and quantitatively evaluate an ADHD-specific CBT sleep intervention—Sleep IntervEntion as Symptom

Treatment for ADHD (SIESTA)—in adolescents with ADHD and sleep problems. SIESTA focuses on enhancing sleep hygiene practices and planning and organizational skills, while using motivational interviewing throughout the intervention to match the specific needs and difficulties of adolescents with ADHD. By doing this, we expect improved intervention adherence and outcomes. The first goal of this pilot study is to fine-tune SIESTA to the needs of adolescents with ADHD and sleep problems by incorporating adolescents' and parents' input and experiences with the intervention. The second goal is to fine-tune the assessment protocol to increase feasibility based on their experiences with the assessments. As end goal, this pilot study works towards a final version of SIESTA that will be tested in a randomized controlled trial (RCT).

## Methods

### Study Procedure

The protocol was approved by the Ethical Research Committee UZ/KU Leuven (S63264). A broad overview of the study procedure and a list of all quantitative assessments can be found in Supplement 1. The pilot study started in September 2020. Before participating, all adolescents and their parents gave informed assent and consent, respectively. During the screening, inclusion and exclusion criteria were examined. After inclusion, the pretest took place, including 2 weeks of keeping a sleep diary and wearing an actigraph to assess sleep. Additionally, adolescents, parents, and a teacher filled out questionnaires via Qualtrics (Qualtrics, Provo, UT). Then, participants received the SIESTA intervention, consisting of six weekly individual adolescent sessions, an optional module of one session, and two parental sessions of 1 hour. After the final session the posttest took place. Posttests were finalized in January 2021, then three focus groups took place; two with the participating adolescents (five in one group and three in the other group) and one with the parents (four mothers). The intervention was provided free of charge and participants received a financial reward for the assessments and participating in the focus groups.

### Inclusion Criteria

Inclusion criteria were (1) attending secondary education and aged between 13 and 17 years, (2) a prior diagnosis of ADHD confirmed by the semistructured diagnostic interview Kiddie Schedule for Affective Disorders and Schizophernia–Present Life Version DSM-5 (K-SADS-PL DSM-5; Kaufman et al., 2016), and (3) displaying sleep problems based on criteria of the DSM-5 (American Psychiatric Association, 2013) and ICSD-3 (American Academy of Sleep Medicine, 2014). Displaying sleep problems was further defined as (a) experiencing a sleep onset latency of at least 20 minutes and/or lying at least 30 minutes awake after sleep onset, (b) and/or less than 7 hours of total sleep time, and (c) showing at least one inadequate sleep hygiene practice, and (d) displaying impairment related to this as indicated by parent and/or adolescent. Further inclusion criteria were (4) an estimated IQ of at least 80 as established by the subtests Vocabulary and Matrix Reasoning from Wechsler Intelligence Scale for Children (WISC; Wechsler, 2014) or the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 2008), and (5) if adolescents used medication for their ADHD, stable medication use at least 1 month before the study and no changes of type nor dose during the study.

Exclusion criteria were specific comorbid disorders—conduct disorder, depressive disorder with suicide risk or active suicidality based on the K-SADS-PL DSM-5 (Kaufman et al., 2016), a diagnosis of autism spectrum disorder based on parent report—and the following sleep disorders: narcolepsy, sleep breathing disorder, and restless leg syndrome as assessed by an extensive sleep interview based on DSM-5 and ICSD-3. Additional exclusion criteria were as follows: substance abuse, apart from nicotine, based on the self-report subscale "Disorders in the use of substances and behavioral addictions" of the Measurements in the Addictions for Triage and Evaluations–youth (MATE-Y; Schippers & Broekman, 2013), and an acute crisis situation at home, physical or medical problems (and medication) causing sleep problems, participation in a CBT sleep intervention in the past 6 months and medication use for sleep (e.g., melatonin), medication use related to anxiety or depression as this medication may affect sleep.

### Participants

For sample characteristics see Tables 1 and 2. Two adolescents dropped out. One adolescent no longer wanted to participate after the pretest and the other stopped after the fourth session. According to the psychologist and the recordings of the sessions, this adolescent had already accomplished some improvement in being more active during the day, gaming less, and falling asleep faster in the first four sessions and did not feel the need to continue with SIESTA. Consequently, eight adolescents completed the training and the assessments (one did not fill out the pretest) and participated in the focus groups. Four mothers also participated in a focus group. Although no melatonin use was allowed as of 2 weeks prior to participation, one adolescent continued their melatonin use

Table 1
Sample Characteristics of Adolescents

| | All included adolescents ($N$ = 10) | | Participated in focus groups ($N$ = 8) | |
|---|---|---|---|---|
| | *M* ± *SD* | *Range* | *M* ± *SD* | *Range* |
| Age | 14.44 ± 1.04 | 13.33–17.08 | 14.55 ± 1.15 | 13.33–17.08 |
| IQ | 97.50 ± 15.12 | 80–131 | 99.63 ± 16.38 | 80–131 |
| PDS | 2.74 ± 0.88 | 1.4–4 | 3.05 ± 0.67 | 2.2–4 |
| | *N* | | *N* | |
| Sex | | | | |
| Male | 4 | | 2 | |
| Female | 6 | | 6 | |
| ADHD presentation | | | | |
| Inattentive | 5 | | 4 | |
| Hyperactive-Impulsive | 3 | | 3 | |
| Combined | 2 | | 1 | |
| Self-reported circadian type | | | | |
| Morning | 0 | | 0 | |
| Intermediate | 1 | | 0 | |
| Evening | 9 | | 8 | |
| ADHD medication use during the study | | | | |
| Ritalin | 4 | | 3 | |
| Equasym | 3 | | 3 | |
| Concerta | 1 | | 1 | |
| None | 2 | | 1 | |

*Note.* PDS = Pubertal Developmental Scale (Petersen et al., 1988)

Table 2
Sample Characteristics of Parents

| | All parents ($N$ = 10) | | Participated in focus groups ($N$ = 4) | |
|---|---|---|---|---|
| | Mother (*N*) | Father (*N*) | Mother (*N*) | Father (*N*) |
| Education | | | | |
| Master/Doctor | 5 | 2 | 3 | 0 |
| Bachelor | 1 | 3 | 1 | 0 |
| Secondary education | 4 | 4 | 0 | 0 |
| Not indicated | 0 | 1 | 0 | 0 |

throughout the intervention. We decided to include the data of this adolescent as our pilot was primarily focused on the subjective experiences with the intervention and not effectiveness.

## Intervention

This newly developed intervention called SIESTA is an ADHD-specific CBT sleep intervention. The main aim of SIESTA is to improve the sleep hygiene of adolescents with ADHD and adapt their sleep patterns to ultimately improve their sleep. SIESTA consists of six general individual sessions with the adolescents and two parental sessions (see Table 3). Additionally, four possible modules of one session can be added, based on the adolescents´ individual needs and sleep problem analysis. The first module focuses on motivation by including a pros and cons table to further explore any ambiguity towards changing the sleep behavior. The second module focuses on circadian rhythm by installing behaviors that increase both exposure to

Table 3
Overview of the Adolescent and Parental Sessions of SIESTA

| Session | Content | Homework |
|---|---|---|
| Session 1 | Psychoeducation on sleep in adolescents with ADHD. Focus on goal setting and adolescent motivation. | Optional behavioral changes in sleep practices based on the psychoeducation. |
| Session 2 | In-depth psychoeducation on sleep hygiene. Investigating the sleep behavior of the adolescent together: What does the adolescent already know and what more information is needed? How to fill out a sleep diary? What are the qualities of a good alarm clock? | Further investigation of their sleep, optional trying out an alarm clock[1], and optional behavior changes in their sleep hygiene practices. |
| Parental session 1 | Psychoeducation on sleep in adolescents with ADHD. Discussion of the balance between controlling the adolescent's sleep ritual/behavior and letting go. | |
| Session 3 | Drawing up a functional analysis of the adolescents' sleep problem and specifying the individual goals of *session 1* based on that. | Behavior changes in line with the individual goals. |
| Session 4 | Installing calmness in the evening. Choosing an individual goal and setting up a behavioral experiment with a possible solution to achieve this goal. | Behavioral experiment and install rest in the evening. |
| Session 5 | Evaluating the experiment from *session 4* and adjusting it if necessary. Choosing a second goal and drawing up a plan for this with a behavioral experiment. | Second behavioral experiment. |
| Parental session 2 | Working on positive communication about sleep. | |
| Session 6 | Evaluation of individual goals and relapse prevention. Adolescent is asked to estimate whether additional modules are needed and, if so, which module(s). | Keep up the behavioral experiments and changes. |
| Optional module | Motivation/Circadian rhythm/Rumination/Planning and organization | |

[1] This alarm clock was chosen to ensure that it is beneficial for sleep and waking based on three criteria. First, it is a digital clock that does not make any noise. Second, the alarm is loud enough to wake up adolescents. Third, there is no illuminated display so it does not interfere with sleep, only when moved there shortly is light to show the time. Furthermore, this is a relatively cheap alarm clock (approximately 5 euro) to limit costs.

daylight and exercise during the day, and on discussing the importance of timing related to those. The third module, rumination, includes different strategies to cope with rumination in the evening (e.g., a rumination box). In the fourth module, planning and organization, the evening is meticulously planned with the aim of reducing later bedtimes or sleep-onset latency (thinking about tasks that were not done yet) due to difficulties planning daily (home)work.

SIESTA is based on a CBT sleep intervention for neurotypical adolescents (Kuin & Boyer, 2019) and a CBT intervention focused on planning and organization for adolescents with ADHD (Boyer et al., 2013). Building on those interventions, elements were added to meet the specific difficulties of adolescents with ADHD, including motivational interviewing and planning and organization throughout the whole intervention. To support their autonomy, adolescents formulate their own goals to work on. Compared to other CBT sleep interventions, less goals are chosen (only one or two goals) to increase feasibility of reaching these goals for adolescents with ADHD. By using experiments to try out new behaviors, adolescents work towards their individual goal(s). To ensure that these are feasible, the psychologist narrows down the steps to reach these goals very explicitly. Furthermore, possible pitfalls (e.g., How will you remember to put your phone in the closet before bedtime? Who can help you with this? What may be reminders?) are discussed for each step. Also, for example, to increase the

likelihood of a behavioral experiment with using an alarm clock, this alarm clock (i.e., one with a loud alarm, no ticking noise, no illuminated display) is provided by the trainer to reduce the potential barrier of the adolescent buying the clock (which, for adolescents with ADHD, could pose a significant hurdle). SIESTA also entails a workbook in which all experiments and steps are written down. This workbook uses infographics with images—if text is necessary, it is short, to ensure that the adolescent is not discouraged by too much text. In the SIESTA trainer manual the goals of each session and more information regarding sleep or specific techniques is included. Much attention is paid to the specifics of working with adolescents with ADHD (e.g., adjusting the pace of the session and speech to the adolescent with ADHD, anticipating forgetting and difficulty following through, finding ways of catching attention, etc.).

The added videoclip shows an adolescent lacking motivation to change their sleep behavior. Halfway, there is a pause in the clip during which psychologists can think about how they would address the situation (in group or individually). Afterwards, the video clip continues with a possible solution. This material has been developed to train psychologists in the SIESTA intervention.

The SIESTA intervention was conducted by three clinical psychologists familiar with CBT. They were trained in implementing SIESTA by the fourth and last author, who are supervisors of the (Cognitive) Behavior Therapy Association in Flanders and the Netherlands, and a CBT sleep specialist from the academic sleep center of the KU Leuven University hospital, who also trains psychologists in CBT for insomnia. Adherence to the intervention protocol was maintained throughout the study through weekly supervision by aforementioned experts. Although SIESTA was designed to be provided face-to-face, due to the COVID-19 restrictions, some sessions had to be provided online.

## Outcomes

*Satisfaction Questionnaire*

Adolescents filled out a satisfaction questionnaire, which included five questions using a five-point Likert scale and five open-ended questions. Parents also rated their satisfaction with SIESTA using four five-point Likert-scale questions and five open questions.

*Focus Groups*

Focus groups took place to gather adolescents' and their parents' experiences with SIESTA and the assessment protocol. Focus groups were chosen over interviews to enhance discussion among participants and generate new ideas (Krueger & Casey, 2008). For adolescents, two smaller groups were chosen over one larger group to create a secure setting that encouraged interaction (Breen, 2006). The semistructured questions were developed with the fine-tuning goal of SIESTA in mind. The moderator kept specific examples on hand in case it was difficult for participants to remember the different components and to allow for further elaboration (see Supplement 2). Focus groups took place online due to COVID-19 restrictions and participants were specifically asked to sit in a room where they could not be disturbed. The first author acted as moderator and the second author as comoderator. All focus groups were transcribed verbatim and all transcripts were anonymized.

*Quantitative Outcome Sleep Hygiene*

Sleep hygiene was analyzed quantitatively as the intervention's main focus is improving sleep hygiene. Other quantitative outcome measures such as sleep diaries and actigraphs were mainly tested for feasibility of the assessment protocol (Supplement 1). The revised Adolescent Sleep Hygiene Scale (ASHSr; 24 items) was administered before and after SIESTA to assess self-reported sleep hygiene. It consists of six subscales: physiological factor (5 items), behavioral arousal factor (3), cognitive/emotional factor (6 items), sleep environment factor (5 items), sleep stability factor (3 items), and daytime sleep factor (2 items). The ASHSr has adequate to good internal consistency ($\alpha$ = .60–.81 for subscales and $\alpha$ = .84 for total scale) (Storfer-Isser et al., 2013).

## Data Analysis

The analytic strategy for the focus group data was based on the principals of thematic analysis (Braun & Clarke, 2006). Codes and themes were identified using the six-stage process of Braun and Clarke (2021). The analytic process began by transcribing the focus groups verbatim. Initial familiarization continued with rereading the transcripts, which were then separately screened for possible codes by the first two authors. Open coding was used, meaning codes were developed and modified throughout the coding process (Maguire & Delahunt, 2017). Following familiarization and notes, the first two authors agreed on a first set of codes in a coding manual. These codes were then classified into broader themes by using constant comparative analysis within and between transcripts. Next, the broader themes were reviewed and refined, leading to the final themes. These were reviewed by all authors to ensure referential adequacy of the transcripts. Any discrepancies were discussed and reconciled. The

entire process of the thematic analysis is outlined in Supplement 3.

To evaluate changes from pretest to posttest on sleep hygiene beyond the limits of chance variation, individual reliable change indices (RCI) were computed (Jacobson & Truax, 1992) using test-retest reliabilities of Chehri et al. (2017). RCI larger than |1.96| were considered statistically significant (Jacobson & Truax, 1992).

## Results

The study flow diagram can be found in Figure 1. The amount of SIESTA sessions varied across participants due to their specific sleep problems, practical issues such as participants arriving late and a bad internet connection during online sessions, and some sessions containing too much content. Five adolescents had eight, two adolescents seven and one adolescent had six sessions. Two adolescents chose the module rumination and three chose the planning and organization module. The other three did not chose a module. Due to COVID-19 restrictions all participants had at least one session online and two participants had all sessions online except for the first session. Five out of eight adolescents wanted to try the alarm clock that was offered in the second session.

### Satisfaction Questionnaire

Generally, adolescents and parents rated SIESTA positive (median scores of mostly 4 for adolescents and parents; Table 4). On the open-ended questions, adolescents reported improvements in their sleep, including not waking up at night, feeling less tired during the day, and having a more structured sleep rhythm. Some, but not all, adolescents reported falling asleep faster. Most adolescents reported that worrying, getting out of bed easier, and yawning during the day did not improve. Parents reported improvement in their adolescents' sleep problems and behaviors, including sleep hygiene practices, and reported that they felt calmer and more aware of the importance of sleep themselves. However, some parents reported that the new behavior was not automatized and were worried about relapse to old habits.

### Thematic Analyses of Focus Groups

All eight adolescents who received SIESTA, participated in two focus groups, one with three and the other with five adolescents. Four of their parents, all mothers, participated in a separate parent focus group. Twenty-six codes and six themes were identified (Supplement 3): *perception of the effect of SIESTA, feeling more ownership over sleep, gaining more insight into adolescents' sleep, experiences with the intervention, parent involvement,* and *challenges with the assessment protocol.* Codes are in italics throughout the text.

#### *Perception of the Effect of SIESTA*

The first theme relates to the perceived effect of SIESTA on the sleep problems of adolescents.

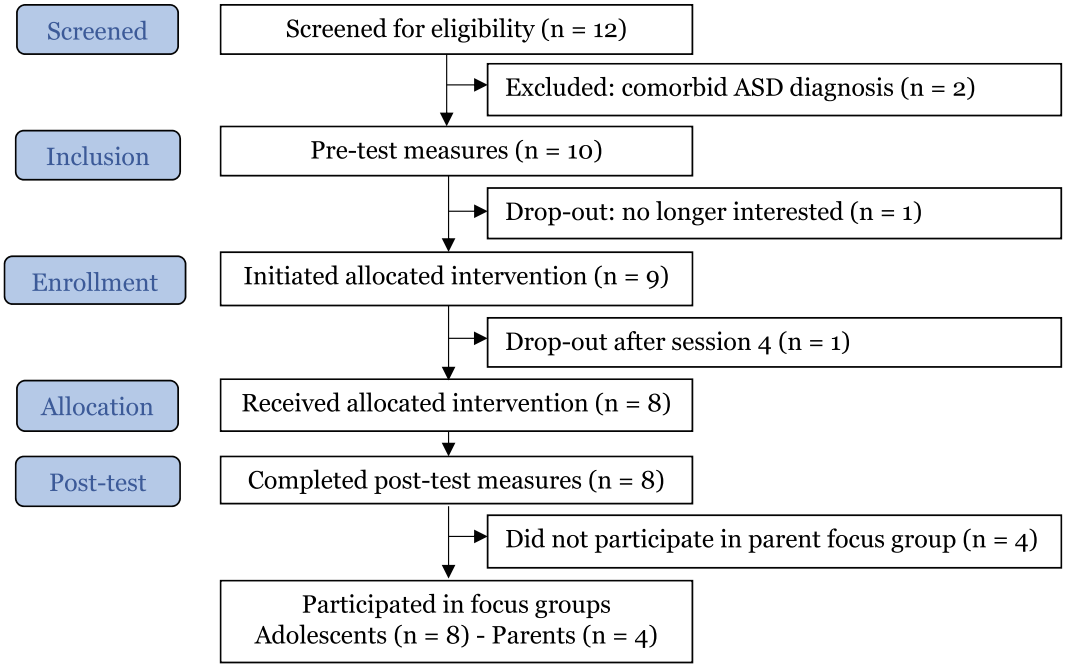


**Figure 1.** CONSORT Study Flow Diagram

Table 4
Closed and Open-Ended Adolescent and Parent Satisfaction Questions

| Closed ended questions | Adolescents | Parents |
|---|---|---|
| | *Median (range)* | |
| How do you rate SIESTA overall? | 4 (2–5) | 4 (2–5) |
| I find the workbook that was used... | 4 (2–5) | N.A. |
| Was SIESTA useful for you? | 4 (2–5) | N.A. |
| How satisfied are you with SIESTA? | 4 (2–5) | N.A. |
| How fun was SIESTA? | 3 (2–4) | N.A. |
| I find the approach to treat my adolescents' sleep problems... | N.A. | 5 (2–5) |
| I expect that SIESTA will yield good results in the future. | N.A. | 4 (2–5) |
| I would recommend SIESTA to other parents. | N.A. | 4 (2–5) |

*Note.* N.A. = question not asked to adolescent or parent; Scale 1 = negative to 5 = positive

| Open ended questions | Adolescents | Parents |
|---|---|---|
| | *N responders* | |
| Which part did you consider to be the best part of SIESTA? | 7 | 7 |
| What content did you miss in SIESTA? | 6 | 4 |
| What suggestions do you have for the content of SIESTA? | 6 | 4 |
| What has improved after SIESTA? | 8 | 5 |
| What has not improved after SIESTA? | 6 | 5 |
| Do you expect that SIESTA will yield results in the future? | 8 | N.A. |
| Would you recommend SIESTA to other adolescents? | 8 | N.A. |

Adolescents reported improvement regarding their sleep, including *more adequate sleep*, *falling asleep faster*, feeling *more awake* during the day and having *more energy*: "... there were huge changes and stuff, that I was really tired in the morning and had no energy, and that has changed now, and it really improved" (adolescent 3). However, one adolescent still felt tired during the day. Parents also reported sleep improvements, but *not all sleep problems were solved*: "... it's ok, even if it's not completely solved, it's ok, I thought that was good" (parent 9).

*Feeling More Ownership Over Sleep*

The next theme related to feeling in control of and competent to change their sleep. After SIESTA adolescents and parents reported a high amount of ownership and felt *more confidence to change* their sleep problems. Adolescents and parents mentioned that *receiving action-oriented advice* during SIESTA allowed them to improve their sleep. "Ehm, yes she [psychologist] gave me tips on how I can do different things and she gave tips on what I can do to fall asleep or to become calm" (adolescent 3). And a parent said that "... in itself, the tips that are given, [adolescent 10] tries to apply them and they do help a little ..." (parent 10). All parents reported *feeling empowered* knowing that sleep problems are common in adolescents with ADHD and that they can be treated. Last, all parents were positive about encouraging *independence* in adolescents. "I think it's really perfect that they did all this independently and all that. I think that's a good thing. They also took that into their own hands and did it well ..." (parent 7).

*Gaining More Insight Into Adolescents' Sleep*

The following theme describes the fact that adolescents and parents started to better understand (their own) sleep. This was due to an interplay of multiple factors: psychoeducation, keeping *track* of their *progress of sleep* throughout SIESTA, thinking about it during the sessions, and looking at the sleep diary and actigraph data. Some adolescents were surprised to learn that their sleep patterns were not always in line with what they thought: "I found that a bit shocking because I always thought when I was filling that [=sleep diary] out, oops, I slept really badly, too little. When they showed those results, I thought shit man, this is still really good. That was strange to see while you lie awake for two hours or longer in your bed and yet sleeping results were still good and I was really blown away" (adolescent 3). Parents also gained *insight into the sleep patterns* of their adolescents. They were relieved to get an objective confirmation of the sleep problems their adolescents complain about and found it interesting to compare subjective and objective sleep data, considering that they often do not know much about the adolescents' sleep: "... But I thought that was an interesting fact to get a new view of what part really is sleeping and is it true that they lie awake for a very long time or is it perhaps shorter but is it in their head, yes, boredom happens very fast, boredom, and thus finding lying awake annoying" (parent 9).

Also, parents gained insight learning about the *link between ADHD and sleep* during the psychoeducation. They appreciated the *acknowledgment* of that link, which reassured them that they are not alone with an adolescent with ADHD and co-occurring sleep problems: "... but also raising awareness of all those things [=link ADHD, sleep and sleep hygiene practices] that was both for [adolescent 1] and for me, things that you knew existed but that you now deal with more consciously in a different way, and [adolescent 1] is now saying, 'ah yes mom, I sleep better now but I don't know if that's because I participated in that project or if it's something else' they are quite a bit critical of it but I think it has triggered something somehow..." (parent 1).

*Experiences With the Intervention*

Adolescents and parents discussed their experiences with every aspect of SIESTA. A common positive aspect was that they felt that SIESTA was *individually adaptable*. Adolescents appreciated that they had the time to go through the content of the sessions without having to rush and that there was a week in between to try out their plans or experiments. "It wasn't a rushed feeling, and it didn't go too fast, that's why, yes from the sessions and stuff, you also had enough time" (adolescent 1). Both adolescents and parents valued that the sessions happened at the pace of the adolescent. When an adolescent was not ready to go on with something new, the psychologist would further elaborate on the current topic. Furthermore, adolescents enjoyed trying out different strategies and not being obliged to carry out an experiment that they did not like. "It really took some searching and if they weren't ready for the next step, well [adolescent 9] anyway, then it was still a bit of thinking and waiting" (parent 9). The *time commitment* to travel to the sessions was discussed by both adolescents and parents. Although they deemed the number of sessions necessary to elicit change in sleep behaviors, it clearly required a lot of effort from the family: "... I think that's very much, it takes us a lot of effort to get that arranged. But that it happens weekly and how long it lasts and stuff, I think that's all ok" (parent 7). Although it was due to COVID-19 restrictions, some parent-adolescent dyads appreciated that some sessions could be held online to compensate for the time commitment difficulties.

Almost all adolescents found it *difficult to set an individual intervention goal*: "I found it especially difficult to set a goal for those things myself, yes, especially to come up with a goal myself" (adolescent 1). They either could not come up with a goal or had multiple goals and had difficulty reducing them to one main intervention goal. Another experience with the intervention is that there was room to talk about stress in general and in relation to sleep and what to do about it, as the majority of the adolescents reported experiencing stress during the day or during the night "... because yes, you did get help and such, not only about sleeping itself but also in general because I was also very stressed about different things and they gave tips about that as well" (adolescent 1). Two adolescents reported that the *relaxation exercises reduced stress*. "For me it was mainly, like, especially during the exams that breathing like inhale–exhale, that helped ... But I also do that sometimes when I can't sleep" (adolescent 2). One adolescent mentioned that the relaxation exercises sometimes helped to reduce stress. After trying out a relaxation technique two adolescents concluded that they did not want to continue trying it out and two did not want to try them out, showing an *aversion to relaxation techniques*. "I don't think there was a problem with that [=relaxation exercises], it didn't work very well for me, but I don't think it's really due to the exercises" (adolescent 7).

All adolescents agreed that they *needed even more structure in the workbook*. Sessions two and three had multiple topics that led to either going over time or needing to finish the previous session during the next session. "I also think that [the workbook] maybe could be changed a bit because that was kind of hard now, because, as [adolescent 2] said at the beginning, that you jump from topic to topic. We were talking about a topic and then the next session we talked about the next topic and the session after that we talked about the first topic and I found that a bit difficult to keep track of. Maybe something can be done about that, I think" (adolescent 3). On top of needing more structure, it became clear that both adolescents and their parents *need more concrete examples*: "... if [psychologist] gave an example, that surely helped" (adolescent 1). Parents found it difficult to come up with concrete phrases that they could use concerning controlling and letting go of the sleep of their adolescent. Therefore, they would prefer to work out hands-on examples to use in the heat of the moment with the psychologist. "As a parent you do feel a bit like that, so in itself there could have been a little more in that or some handles or let's find out together, or it's also ok to say 'I would do that differently' or ... But something more, I think. I found that interesting and I certainly thought it was useful, but it didn't stick" (parent 9).

Last, in both adolescent and parent focus groups, the *need for repetition* came up. Looking at the previous week and how it went was helpful for adolescents to keep track of their progress and to experience what works for them and what does not: "Good follow-up, and that is especially so, I thought we had enough

conversations and looked back on the previous topic every time" (adolescent 10). Parents questioned whether there is a *need for follow-up* sessions. They recognized the importance of keeping up with the new behaviors after the intervention and wondered whether the last session would be enough to prevent relapse. "I think I am disappointed that it has remained way too much within the study. And I would have preferred that we could have taken a lot more from it. That what [adolescent 7] learned, I think some things only work if you keep them up for a long time, eh, logically..." (parent 7). However, adolescents did not report concerns regarding relapse.

## Parent Involvement

Adolescents and parents discussed different needs regarding the two parental sessions of SIESTA. *Adolescents* were generally *satisfied with the balance between autonomy and parental involvement*. Apart from one adolescent who was the eldest participant (17 years old), all adolescents found it useful that parents were informed throughout SIESTA: "... it is good that they can go there so they also know what it is about" (adolescent 2). Parents also mentioned that adolescents did not talk about the intervention spontaneously, so the parental sessions helped to stay up to date. "I thought that was good [referring to the parental sessions] because then they would also stay updated with all the sessions and what happened and so on, so I thought that was good" (adolescent 1). Adolescents also appreciated that parents could help them with their sleep plan if needed. They mainly wanted help in the form of reminders: "I also found it [refers to parents being involved] useful because I often forget things and mom reminded me that I still had to do that or something" (adolescent 9). Further, adolescents acknowledged that parents sometimes have additional information regarding their sleep such as snoring and sleep walking behavior.

Although adolescents were satisfied with the parental involvement as it was, *parents* expressed a *need for more involvement*. They wondered whether they could do more to assist their adolescent in order for the new sleep behaviors to sustain. "I think it's great that they tackle that independently, but that also means that you may not be there to say, 'But they said that didn't they?' or 'Didn't they say you have to do that?' So, I think that's ambiguous, I think that's positive but at the same time also a little bit negative but not completely negative either" (parent 7). Parents came up with three possible ways to comply with their need for more parental involvement. First, parents suggested meeting other parents of adolescents who receive SIESTA to hear from other parents how they deal with certain topics such as smartphone use before bed. "I don't think it's bad that we can discuss with each other a bit." (parent 9). Second, parents proposed an online parent platform on which parents could keep track of what their adolescent is doing: "... you sometimes look so you know what they are doing, you look over their shoulder to see if it's all going well" (parent 7). Last, parents wanted to be trained so they could prevent relapse. Specifically, parents wanted to learn more about the different sleep hygiene practices and relaxation exercises: "... If you can go back to a few, yes things that they've done, and you can point them back or indeed do those things together. I think that could be interesting as well" (parent 7).

### *Challenges With the Assessment Protocol*

The last theme identified was related to the assessments. The main issue adolescents mentioned was forgetting the daily assessments. Specifically, they forgot to fill out the sleep diary. "Yes, one thing I found a bit difficult and that was the diary because I don't know why but I forgot that very often, I forgot that three times or so" (adolescent 1). This was confirmed by the sleep diary data with none of the adolescents filling in the sleep diary for the complete 2 weeks at pretest (*Mdn* = 10.5, range 5–13) and only one adolescent being able to complete 2 weeks of assessment at posttest (*Mdn* = 8, range 3–14). Furthermore, adolescents mentioned forgetting to press the button on the actigraph or forgetting to put the actigraph back on in case they removed it during the day. Parents recognized this as well. When looking at the number of days adolescents wore the actigraph, it again became clear that a period of 2 weeks to objectively assess sleep was too long. Only two adolescents wore the actigraph for 2 weeks at pretest (*Mdn* = 12.5, range 9–14) and two at posttest (*Mdn* = 9, range 4–14). Consequently, adolescents made clear that they *need reminders regarding the sleep diary and the actigraph*. Simply sending a text containing the link to the sleep diary is insufficient. "I would get a message and then I would see it but I would forget about it" (adolescent 1). However, in general, receiving reminders in the form of a text was effective and seen as positive, according to parents. "What I did think was positive was that you always sent a message via text message or I don't know via social media 'Be careful, don't forget' and [adolescent 10] thought that was very positive" (parent 10).

Additionally, adolescents discussed that they *needed more explanation on how to use the sleep diary and the actigraph*. They received the instructions during the 2-hour screening in which this information was given next to other information. They expressed trouble remembering the exact instructions. "I understood

that, apart from the first time, I had put it [=actigraph] on the wrong arm, apparently it should be on, I don't remember which hand but yes, after that I did it correctly." (adolescent 1). Three adolescents found the *actigraph unpleasant* to wear. This was partially due to the physical feeling, but also the worry about what others might think. "I don't know, I don't normally wear watches, and that was sometimes annoying because, yes I don't know, that was not really a habit of mine to always wear a watch and some people asked, 'What is that?' and then I had to explain that completely" (adolescent 9).

The last part of the assessment that was discussed were the *questionnaires*. Some adolescents thought the questionnaires took rather long to fill out. Furthermore, both adolescents and parents were surprised by some of the topics of the questionnaires. They only expected questions about sleep and ADHD. "I also thought the questionnaires were too long because sometimes I did not really understand the connection with this study [e.g., questions regarding depressive symptoms]" (adolescent 10).

### Quantitative Outcome Sleep Hygiene

All adolescents significantly improved on at least one of the subscales of the ASHSr. Additionally, all adolescents significantly improved on the physiological factor, measuring (e.g., evening caffeine consumption, going to bed hungry). The cognitive/emotional factor, on which four adolescents improved, includes rumination. Two adolescents improved on the behavioral arousal factor (e.g., less engaging activities in the evening). Two adolescents improved on the sleep environment factor, indicating that their bedroom is better attuned to sleep. Last, on both the sleep stability factor (e.g., different bedtime/wake time pattern on school nights and weekend nights) and the daytime sleep factor (e.g., napping), one adolescent significantly retrogressed (Table 5).

## Discussion

This pilot study qualitatively and quantitatively evaluates a new CBT sleep intervention developed specifically for adolescents with ADHD and sleep problems. The satisfaction questionnaires showed that adolescents and parents were generally satisfied and most would recommend SIESTA to others. Qualitative findings indicate that both adolescents and parents mainly reported positive effects of SIESTA, but also mentioned some points of improvement. Quantitative findings showed that all adolescents significantly improved on at least one factor of sleep hygiene.

A central topic discussed in the focus groups was the perception of the effect of SIESTA. Both adolescents and parents reported improved sleep, including more adequate sleep, feeling more awake and energetic, and falling asleep faster, which is encouraging as SIESTA aims to improve these sleep outcomes. This is in line with results from the pilot study of TranS-C-Y in which adolescents and parents reported improvements in sleep and less daytime sleepiness (Becker, Duraccio, et al., 2021). However, specifically parents reported that not all sleep problems were solved. This might be partially due to the fact that parents are not always aware of their adolescents´ sleep behaviors, as more independence is common in this developmental phase. Consequently, it might be difficult for them to notice specific changes, such as changes in bedtime or sleep duration (Short et al., 2013). Moreover, we noticed that parents became more aware of the scope of the sleep problems of their adolescents throughout the study by discussing their sleep and paying attention to it.

Another topic mentioned was feeling more ownership over sleep. Adolescents reported more confidence in their ability to change their sleep. This is a desirable effect as it can facilitate change and compliance with interventions (Tang & Harvey, 2004). In SIESTA the aim is supporting autonomy of adolescents. Although

Table 5
Reliable Change Indices of the Revised Version of the Adolescent Sleep Hygiene Scale

| Screening numbers of participants | Total | Physiological factor | Behavioral arousal factor | Cognitive/ emotional factor | Sleep environment factor | Sleep stability factor | Daytime sleep factor |
|---|---|---|---|---|---|---|---|
| 1 | 3.65* | 11.89* | 5.40* | 1.78 | 1.39 | 1.41 | 0.00 |
| 2 | 0.84 | 7.13* | 0.99 | 0.00 | 0.00 | 1.41 | 0.00 |
| 3 | −0.44 | 5.94* | −0.49 | 2.70* | 0.69 | −0.48 | −3.34* |
| 5 | 3.61* | 9.12* | 0.00 | 9.88* | 3.47* | 1.88 | 0.00 |
| 6 | 0.29 | 3.95* | 1.47 | 8.10* | −1.39 | −3.29* | 0.00 |
| 9 | 1.72 | 7.73* | 0.97 | 7.18* | 2.77* | 0.95 | 0.00 |
| 10 | −0.22 | 8.11* | 1.96* | 0.92 | 1.39 | −0.47 | 0.00 |

* Significant RCI's.

adolescents experienced this as difficult, this process of giving them autonomy may have led to real ownership of their sleep. Parents felt empowered by knowing that ADHD and sleep are related, underlining the importance of psychoeducation (Dahl et al., 2020).

In general, adolescents and parents valued that SIESTA is adaptable to the individual needs of the adolescents and that it is implemented at an individualized pace. Moreover, positive experiences were reported with the ability to discuss experienced stress. The focus on stress is not surprising as adolescents with ADHD have higher perceived stress levels compared to adolescents without ADHD (Frick et al., 2022). However, there were different opinions regarding the relaxation exercises incorporated in SIESTA. For some adolescents they were helpful to diminish experienced stress (related to sleep) but for others the idea of using relaxation techniques was aversive and not all adolescents were willing to try them. This is highly relevant information as relaxation techniques are often part of regular CBT sleep interventions while some adolescents with ADHD may find them particularly aversive due to a lack of stimulation and their aversion to waiting and delay (Sonuga-Barke et al., 2008). Again this highlights the need for individual tailoring of intervention techniques.

Adolescents and parents also mentioned points of improvement. Involving our target group in the fine-tuning process allowed us to optimally tailor the intervention to their needs and increase the effectiveness for the upcoming RCT (Becker, 2020). It can also increase feasibility, intervention engagement and adherence, thereby improving intervention outcome (Bussing et al., 2016). Moreover, by incorporating the viewpoint and experiences of adolescents with ADHD, we expect that the validity and reliability of the assessment protocol will be improved (Bussing et al., 2016). Adolescents would have preferred more structure in the workbook, including more equally spread content across sessions. Consequently, we restructured the content and increased the number of sessions to seven, with less topics in each session to allow for more focus and to diminish burden on their executive functioning. To further reduce the amount of information that adolescents need to read, the amount of text in the workbook per session was even more shortened. The deleted text was added in an appendix so that all the information is still available. Next, colored sheets were added to have more structure throughout the workbook; green sheet = progress of sleep, blue sheet = goals, and large yellow sheet = individual sleep plan. These are revisited every session so that adolescents have a more structured overview of their progress. Another point of improvement was that they would have preferred more specific examples. Therefore, lists of explicit examples were made available in the final version of the workbook. An overview of the final content of the sessions of SIESTA can be found in Supplement 4.

The last point of improvement mentioned by adolescents and parents was the time commitment. Although they deemed the number of sessions necessary, it required a lot of effort, particularly in terms of travel time. Again, this is in line with the findings of the pilot study of TranS-C-Y where both adolescents and their parents noted the commitment to travel to and participate in the in-person sessions (Becker, Duraccio, et al., 2021). A possible solution may be to provide the intervention online; in this pilot study some (but not all) adolescents and parents valued the online sessions alongside the face-to-face sessions. Online CBT sleep interventions for neurotypical adults with sleep problems and parent-mediated interventions for children with ADHD and sleep problems seem effective (Corkum et al., 2016; Espie et al., 2012; Vincent & Lewycky, 2009). However, there are a number of shortcomings when considering online interventions for adolescents with ADHD. They are more difficult to motivate in an online session and more easily distracted (McGrath, 2020; Santosh et al., 2023). This is in line with our clinical experience. In the pilot study slow internet, bad lighting, or a broken camera made it more difficult to adequately connect to the adolescent, which may have affected treatment integrity and compliance. Privacy was another difficulty as in some cases there was no separate room or people entered during the session. For our upcoming RCT, we chose face-to-face sessions to enhance treatment integrity and to ensure privacy of the adolescent. To reduce travel time for the participating families of the RCT, we expanded the locations where SIESTA can be provided. For future interventions, providing intervention at locations close to the daily lives of adolescents (e.g., school settings) should be considered, as it may further reduce this experienced barrier (Evans et al., 2016).

With regards to experiences with the assessment protocol, adolescents particularly expressed difficulties with the sleep diary. They often forgot to fill them out, the application used was not practical, the time period of having to fill out the diary was too long, and the questions were not formulated clearly enough. This may be related to their noted executive function difficulties (Sonuga-Barke et al., 2008). To account for this in the RCT, the time period to fill out the sleep diary and wear the actigraph was reduced to 1 week: five school nights and two weekend nights are enough to reliably calculate sleep parameters (Acebo et al., 1999). Moreover, a different and more user-friendly

application was chosen for the sleep diary (m-Path by Mestdagh & Verdonck, 2019), which automatically sends two reminders a day at times defined by the adolescents and potential extra reminders in the form of memes. This is in line with the feedback adolescents with ADHD gave after TranS-C-Y, indicating that they prefer a mobile application to complete a sleep diary with electronic reminders (Becker, Duraccio, et al., 2021). Furthermore, in our RCT the questions are simplified, the diary will be discussed more thoroughly, and an instruction sheet is provided as reminder. Last, to meet the need for immediate reward of adolescents with ADHD and to increase compliance, the monetary reimbursement will be based on the number of days the sleep diary is filled out.

Looking at the quantitative findings, every adolescent showed clinically reliable change in at least one sleep hygiene practice after SIESTA and all adolescents improved on the physiological factor, indicating SIESTA meets its primary goal. These results are promising, as sleep hygiene is an important predictor of sleep quality and self-reported sleep problems (Martin et al., 2020). That adolescents improved on different sleep hygiene factors is not surprising, as inadequate sleep hygiene practices and specific sleep problems also varied between adolescents before SIESTA. Findings on the sleep stability factor differ with half of the adolescents improving and one adolescent significantly retrogressing. COVID-19 restrictions (lack of structure, combination remote and live classes) may have had an influence here, as these varied across adolescents and may be particularly difficult for adolescents with ADHD (Becker, Dvorsky, et al., 2021).

There are some limitations to this study. First, COVID-19 and its related school and societal measures in Flanders could have interfered with the current results. At pretest adolescents went to school regularly as it was a period with relatively few COVID-19 cases, and at posttest they attended school 50% face-to-face and 50% online or with self-study tasks. Studies show that adolescents with ADHD show more sleep problems during COVID-19, which could have also impacted these results (Becker, Dvorsky, et al., 2021). Some sessions were held online due to COVID-19 restrictions. All participants had at least one session online, which could have influenced the results. Second, generally in adolescents with ADHD there are often issues with intervention compliance and following through (Johnson et al., 2008); also in our study, two adolescents stopped the intervention prematurely. We critically evaluated these cases and concluded that these adolescents were not experiencing enough distress themselves for behavior change. Therefore, in our future trial we will more thoroughly evaluate the distress related to sleep problems and only include those with distress. Moreover, in anticipation of possible intervention dropout, we will recruit an additional 15% of participants. Third, one adolescent wanted to continue taking melatonin throughout the study, although this was specifically mentioned as an exclusion criterion. As our pilot was primarily focused on subjective experience with the intervention and not effectiveness, we did decide to include the data of this adolescent. This adolescent did improve on sleep hygiene but the effect of the intervention without the influence of melatonin could not be evaluated. Unfortunately, the use of melatonin throughout the study cannot be controlled. Therefore, for the RCT, the possibility of adolescents not complying with this exclusion criterion will be taken into account by thoroughly assessing medication use and/or change at posttest and follow-up, which allows for potential sensitivity analyses. Fourth, the parents that participated in the focus groups were all highly educated mothers, which might limit the generalizability of the parental experience. Fifth, no quantitative outcomes, except for sleep hygiene, were assessed, as they were only included to assess feasibility. In our RCT, the effect of SIESTA on other primary and secondary outcomes such as total sleep time and ADHD symptoms will be evaluated. Last, the quantitative data of the sleep diaries and actigraphs showed substantial missing data. Only one adolescent filled out the sleep diary for 2 weeks at posttest but not at pretest, and only one adolescent wore the actigraph for 2 weeks both at pretest and posttest. In addition to difficulties with executive functioning of adolescents, COVID-19 restrictions (with often alternating actual and virtual schooldays) may have contributed to the missing and unreliable data. Assessments often stretched over 4 weeks to obtain barely 2 weeks of sleep diary and actigraphy data. We have adjusted this in our RCT, which shows the importance of co-designing studies to increase their feasibility.

To conclude, preliminary findings indicate satisfaction with SIESTA, more ownership over the sleep of adolescents, and improvements in sleep hygiene in adolescents with ADHD after SIESTA. Based on the feedback in the focus groups, SIESTA and the assessment protocol for the upcoming RCT was fine-tuned towards the target population. This is highly relevant to increase the feasibility and acceptability, which may be particularly important for adolescents with ADHD as they are a group that often drops out of treatment and shows less compliance. As a next step, SIESTA's effectiveness will be tested against treatment as usual in an RCT (Keuppens et al., 2023).

## Appendix A. Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cbpra.2023.12.001.

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