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Efficacy of Internet and Group-Administered Cognitive Behavioral Therapy for Insomnia in Adolescents: A Pilot Study

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Research indicates that adolescents are at risk for insomnia, but are reluctant to seek help. Treatment of insomnia has been extensively examined in adults, but studies with adolescents are sparse. The purpose of this pilot study was to assess feasibility and efficacy of cognitive behavioral therapy for insomnia (CBT–i) for adolescents in both group and Internet settings. Twenty-six adolescents received 6 weekly sessions of CBT–i in a group ($N = 13$) or individual Internet setting ($N = 13$). Their sleep was measured with actigraphy, sleep logs, and questionnaires at baseline, posttreatment, and a 2-month follow up. For both treatments, results show a significant improvement, with medium to large effect sizes (ESs) of sleep onset latency, wake after sleep onset, and sleep efficiency. There was also a small ES increase of total sleep time in sleep log measures, but not in actigraphy measures. On questionnaires measuring symptoms of insomnia and chronic sleep reduction, significant improvements occurred either at posttreatment or at follow up. No differences were found between the groups. This study indicates CBT–i, either in group or in Internet formats, is an effective treatment for insomnia in adolescents. Further studies in a randomized controlled design are warranted.

Sleep is regarded as an important precondition for normal adolescent development (Dahl & Lewin, 2002), yet studies show that many adolescents do not get sufficient sleep due to sleep disturbances like insomnia. Insomnia complaints are difficulties falling asleep, difficulties staying asleep, or not feeling rested after getting up. Roberts, Roberts, and Chen (2002) found a 1-year incidence of 5.3% of insomnia according to the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–IV*; American Psychiatric Association, 1994) criteria among adolescents aged 11 to 17. Johnson, Roth, Schults, and Breslau (2006) found a lifetime prevalence of insomnia as defined in the *DSM–IV* in adolescents aged 13 to 16 of 10.7%, during their lifetime up

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until age 16. Furthermore, they found 88% of those with previous insomnia reported current insomnia, which suggests a highly chronic disorder even at such a young age. Generally, sleep problems in adolescents tend to persist over time (Morrison, 1992; Roberts, Roberts, & Duong, 2008; Thorleifsdottir, Björnsson, Benediktsdottir, Gislason, & Kristbjarnarson, 2002), and can have serious consequences for physical and mental health, as well as social and cognitive functioning (Curcio, Ferrara, & De Gennaro, 2006; Fallone, Owens, & Deane, 2002; Meijer, Reitz, Dekovic, van den Wittenboer, & Stoel, 2010; Wolfson & Carskadon, 2003). Cognitive behavioral therapy for insomnia (CBT–i) is the first choice in the treatment of adults (Morin, 1999), and has been proven effective in the long term (Morgenthaler et al., 2006).

CBT–i consists of a combination of stimulus control, restriction of time in bed, sleep hygiene, relaxation, and cognitive therapy. These techniques are recommended as effective therapy for insomnia by the Standards of Practice Committee of the American Academy of Sleep Medicine (Morgenthaler et al., 2006). This treatment is also used for adolescents (Stores, 1996), but research into its effectiveness for this age group is sparse (Boonstra, Stins, Daffertshofer, & Beek, 2007). In a study with 55 adolescents, Bootzin and Stevens (2005) found improvements in sleep efficiency (SE) and total sleep time (TST) and a reduction in sleep onset latency (SOL) and number of awakenings after six sessions of cognitive behavioral group therapy. That study, however, was conducted with adolescents who had been treated for substance abuse, and the authors concluded there was a strong interaction between sleep problems and substance abuse. In a single-subject study with three adolescents, Norell-Clarke, Nyander, and Jansson-Fröjmark (2011) studied the effectiveness of cognitive therapy for insomnia (Harvey, 2005) and found reduced SOL, but no change in TST. These two studies suggest that cognitive (behavioral) therapies are effective in youth with insomnia.

Adolescents, more than adults, are found to be reluctant to seek help for psychological problems at public mental health services (Cheng, 2009; Logan & King, 2001). As a result, effective treatments may be underused by this group. One study showed that online health services may be more accessible for adolescents (Havas, de Nooijer, Crutzen, & Feron, 2011). In a study on a cognitive behavioral intervention for children and adolescents with chronic pain, Palermo, Wilson, Peters, Lewandowski, and Somhegyi (2009) found support for efficacy and acceptability. Another study showed online behavioral pediatric health-promoting interventions produce small, but homogenous, effects (Cushing & Steele, 2010). These studies indicate that online applications of behavioral interventions are promising forms of treatment for adolescents.

Five studies using online CBT–i for adults suffering from insomnia showed positive effects on sleep. First, Ström, Pettersson, and Andersson (2004) found improvements in TST, SE, and total wake time, among others, for 30 insomnia patients after a 5-week treatment with an online cognitive behavioral self-help intervention. Second, Vincent and Lewycky (2009) found improved sleep quality and reduced insomnia severity and daytime sleepiness in 118 adults with chronic insomnia. Third, Lancee, Van den Bout, Van Straten, and Spoormaker (2012) showed improvement on most sleep measures, insomnia symptoms, depression, and anxiety in 216 adults with chronic insomnia after online self-help CBT–i. Fourth, Ritterband et al. (2009) revealed improvement in the Insomnia Severity Index and primary sleep outcomes in 22 adults with a history of sleep difficulties of 10 years or more. Fifth, Espie et al. (2012) found a sustained improvement of SE from sleep log measures and improved daytime outcomes and sleep–wake functioning in 55 insomnia patients that were treated with six online CBT–i sessions with an animated therapist, in comparison to 54 patients with treatment as usual and

55 patients with a placebo imagery relief therapy. Note that none of these studies of online CBT–i were conducted with adolescents, although adolescents are at risk for insomnia, and online CBT–i may be a more accessible and preferred form of treatment for this age group.

This study aimed to investigate the feasibility and efficacy—both immediate and at a 2-month follow up—of a CBT–i protocol for adolescents in online, therapist-mediated, Internet and group treatments.

METHOD

Participants

Participants were recruited through newspaper articles and electronic newsletters on Web sites for youth health care professionals in the Netherlands. The main inclusion criterion was presence of insomnia complaints for at least 4 weeks for at least 3 days per week based on self-reports and the Insomnia scale of the Holland Sleep Disorder Questionnaire (HSDQ; Kerkhof et al., 2012). Exclusion criteria were being an age outside the range of 13 to 19, not (yet) in secondary or high school, living more than 1 hr away from Amsterdam to be electable for group treatment, indications of other psychological disorders (including suicidal plans and drug abuse) through clinical scores on the Youth Self-Report (YSR; Achenbach, 1991; Verhulst, van der Ende, & Koot, 1997) and from the intake interviews, or indications of sleep disorders other than insomnia through scores above the cutoff on the HSDQ and through information from the intake interviews. Participants who were presently being treated for psychological or sleep problems, used drugs that interfere with sleep, or showed a lack of chronicity or severity of the symptoms as indicated in the questionnaires or the intake interviews were also excluded.

The first seven participants who registered were included in the Internet treatment, as that condition was ready to start at that time. The next 20 participants were randomly included in the group condition or Internet condition. One participant from the group treatment dropped out after the second session due to sleep problems caused by a severe delayed sleep phase syndrome that interfered with the treatment. She was referred to a sleep clinic for further diagnosis, and was not included in the analyses. There remained 13 participants in both conditions.

Measures

Measurements were obtained 2 weeks before treatment (baseline), at the end of the treatment (posttreatment), and 2 months after treatment just before the booster session (follow up). As a primary endpoint, SE was chosen because it contains information on difficulties falling asleep and difficulties staying asleep (Morin, 2003). We also included TST as a primary measure as this is not reflected by SE (in fact, because of sleep restriction exercises during treatment, SE is likely to improve while there may be no improvement in TST at all) and has been recommended in other sleep research (Espie et al., 2012). We operationalized these sleep parameters in both objective and subjective measures from actigraphy and sleep logs as recommended by Kushida et al. (2001).

Sleep. Sleep was measured using wrist actigraphy (Actiwatch® AW4; Cambridge Neurotechnology Ltd., Cambridge, England) and sleep logs for 7 consecutive nights at all three mea-

surement occasions. Activity during the night was recorded with 1-min epochs, and analyzed with Actiwatch Sleep Analysis 7 software measuring SOL, wake after sleep onset (WASO), TST, time in bed, and SE (= percentage TST of TIB). TST = TIB − SOL, WASO, and time between waking up and getting up. We used the medium sensitivity algorithm as recommended by the manufacturer, which has the best sensitivity (0.96), specificity (0.42), and accuracy (0.79) for insomnia based on estimates obtained from polysomnography (PSG; Kushida et al., 2001).

Participants were instructed to wear the Actiwatch on their non-dominant wrist when they went to bed and remove it in the morning after getting up. According to recommendations from other studies (Littner et al., 2003; Sadeh & Acebo, 2002), we visually examined all actigraphy data and corrected them where necessary. We applied the following general rule for data from the sleep logs or event markers from the Actiwatch that did not correspond with the visual inspection: If the sleep log indicated a bedtime at which it was obvious from the actigraphy data that the participant was already asleep, we set the bedtime to the first peak before the drop-off. If the reported time of getting up in the sleep log indicated a time at which it was obvious that the individual was still asleep, we corrected the data by changing the time of getting up to the first peak after the indicated time.

The sleep log consisted of eight questions registering bedtime, time of lights out, SOL, WASO, wakeup time, and get-up time. From the bedtimes of the sleep logs, we calculated TIB, TST (= TIB − SOL, WASO, and time between waking up and getting up), and SE (= percentage TST of TIB). Participants were instructed to fill out the sleep log every day within 1 hr after getting up, and received a reminder text message on their mobile phone if the sleep log was not completed before 4:00 p.m. Sleep logs could be filled out up to midnight the following day, at the latest, as retrospective data with a larger time span were considered unreliable.

Questionnaires. The HSDQ (Kerkhof et al., 2012) consists of 40 items, scored on a 5-point rating scale, to diagnose common sleep disorders and is based on the six main categories of sleep disorders as described in the *International Classification of Sleep Disorders-Second Edition* (American Academy of Sleep Medicine, 2005). It contains six subscales for insomnia, sleep-related breathing disorders, hypersomnia, circadian rhythm sleep disorders, parasomnia, and restless legs syndrome or periodic limb movement disorder. Cronbach's alpha in a Dutch sample of 1,269 patients and 412 participants without sleep complaints was 0.90 and ranged from 0.73 to 0.81 for the six subscales. The overall accuracy was 88%, and a score above the cutoff of 3.68 on a range of 1 to 5 on the Insomnia scale is an indication of insomnia.

The Chronic Sleep Reduction Questionnaire (CSRQ; Dewald, Short, Gradisar, Oort, & Meijer, 2012) consists of 20 items of three ordinal response categories (1–3) that measure symptoms of chronic sleep reduction in the previous 2 weeks. It has four subscales: *shortage of sleep* (6 items), *irritation* (5 items), *loss of energy* (5 items), and *sleepiness* (4 items). Higher scores indicate more chronic sleep reduction. Cronbach's alpha in a preadolescent population was 0.84 (Meijer, 2008), 0.85 in a Dutch adolescent population, and 0.87 in an Australian adolescent population (Dewald et al., 2012).

Treatments

The protocol for CBT–i was adapted for adolescents by the research team and an experienced sleep therapist in content and order of the separate components of CBT–i (Morgenthaler et al.,

2006; Morin, 1999). The components included in both the protocol for group treatment and the protocol for Internet treatment were sleep hygiene and psychoeducation, sleep restriction, stimulus control, cognitive therapy, and relaxation. The components were ordered over six weekly consults and a booster session 2 months after the sixth consult in a similar fashion for both the group and Internet therapies. See Table 1 for an overview of the treatment modules.

All CBT–i therapists for both conditions were certified sleep specialists. In addition, the Internet therapists received a day-long training in online conversation skills with chat and online therapy techniques. For all consults, the therapists met for group intervision with an experienced sleep therapist.

Participants in the Internet condition were assigned to one of the sleep therapists for the duration of the treatment. The Internet therapy consisted of a personalized Web site that participants could log on to and where they received a consult at a fixed time and day of the week. The day before each consult, except the first consult, the participants in the Internet condition filled out a short evaluation questionnaire rating how well the exercises of the last week worked, using a 4-point scale ranging from 1 (*very well*) to 4 (*not at all*).

The consults consisted of several online pages in a fixed order with text, movies, pictures, and short interactive questionnaires containing exercises and explanations based on the CBT–i components. Each consult started with one page with an overview of their personal sleep variables data from the sleep logs, automated feedback dependent on the answers to the evaluation questionnaire of the day before, and a short paragraph with written feedback from the sleep therapist introducing new bedtime advice and further comments on participants' evaluations of previous exercises. The last page of each consult contained a short overview of techniques introduced in the consult and a list of exercises for the coming week. On this page, participants could also send a question or comment to the therapists. In the week after the second consult, participants were invited to a 15-min chat session with their therapist online. This one-time chat session was aimed at improving therapy commitment early on in the 6 weeks, as studies have shown that online treatment with therapist input and guidance improves therapy adherence and outcomes (Clough & Casey, 2011; Jernelöv et al., 2012; Palmqvist, Carlbring, & Andersson, 2007).

Participants who participated in one of the two groups (of 6–7 participants) came to a weekly group meeting in a local youth mental health center in Amsterdam. The six sessions were conducted by two trained sleep psychotherapists, and lasted 1 1/2 hr each. The content of the sessions was similar to that in the Internet condition, and presented in a group therapy fashion. Also in the group condition, in each consult, participants received personal advice for bedtimes based on the sleep variables from the sleep logs. Furthermore, participants received take-home exercises and printed background material on what was covered in each session.

Procedure

The study was approved by the medical ethical committee of the Academic Medical Center in Amsterdam. After registration through a Web form, participants received extensive information on the study, and signed informed consent. They then received a user name and password to log on to a restricted access page on the Web site with their personal password to fill out the YSR, the HSDQ, the CSRQ, and questions on social economic statuses and school levels.

TABLE 1
Content of the Weekly Consults in the Group Therapy and Internet Therapy Conditions

Week	*Group Therapy*	*Internet Therapy*
1	*Overview:* Participants get a general overview of the coming 6 weeks. Therapists and participants introduce themselves. Participants tell about main sleep problem and complete a motivation exercise. *Psychoeducation:* Information on sleep, its functions, and characteristics of sleep in adolescents is provided. *Sleep hygiene:* Therapists provide information on sleep hygiene. Participants discuss their habits and routines related to sleep hygiene, and identify their personal three sleep hygiene points to work on. *Sleep logs:* A print-out overview with graphs and means over the past week of all personal sleep variables from the sleep logs of the participants are presented. *Sleep restriction:* Participants discuss individual information on their sleep variables from the sleep logs and information on the significance of sleep efficiency and how restriction of time in bed can help improve sleep. They get individual bedtime instructions for the coming week based on restriction of time in bed. *Homework:* Participants get a list summarizing subjects and assignments that were covered in this consult for the coming week, including bedtimes.	*Overview:* Participants get a general overview of the coming 6 weeks. *Sleep logs:* An overview with graphs and means over the past week of all personal sleep variables from the sleep logs of the participants are presented. *Psychoeducation:* Information on sleep, its functions, and characteristics of sleep in adolescents is provided. *Sleep hygiene:* Therapists provide information on sleep hygiene. With an exercise and questionnaire, participants identify their personal three sleep hygiene points to work on. *Sleep restriction:* Participants receive individual information on their sleep variables from the sleep logs and information on the significance of sleep efficiency and how restriction of time in bed can help improve sleep. They get individual bedtime instructions for the coming week based on restriction of time in bed. *Homework:* Participants get a list summarizing subjects and assignments that were covered in this consult for the coming week, including bedtimes and personal sleep hygiene points.

(*continued*)

TABLE 1
(*Continued*)

Week	*Group Therapy*	*Internet Therapy*
2	*Sleep logs:* Similar to the previous week, including new bedtime instructions. *Feedback on homework:* In small subgroups, participants discuss the assignments on sleep hygiene and bedtimes of the previous week. They identify possible new points to work on, and get feedback from the therapists. *Exercise on worry:* The mechanisms of worry while lying awake are explained and discussed. An exercise is introduced to write worries or repetitive thoughts in a personal diary in a systematic way well before going to bed. *Relaxation:* Participants receive information on relieving tension through relaxation, and do a live body scan exercise as a relaxation technique. They receive a CD with this exercise for daily practice. *Homework:* Similar to the previous week.	*Sleep logs:* Similar to the previous week. *Feedback on homework:* The day before the consult, participants fill out a short questionnaire on sleep hygiene and bedtimes of the previous week, rating how well these exercises were applied and how they worked. Based on these questionnaires, participants receive automated personal feedback. *Personal feedback from therapist:* Participants get personal feedback (about 1 or 2 paragraphs) introducing new bedtime instructions and, if necessary, points for special attention from the exercises of the previous week. *Exercise on worry:* The mechanisms of worry while lying awake are explained and discussed. An exercise is introduced to write worries or repetitive thoughts in a personal diary in a systematic way well before going to bed. *Relaxation:* Participants receive information on relieving tension through relaxation, and get a body scan exercise as a relaxation technique. They can download this as an mp3 for daily practice. *Homework:* Similar to the previous week. *Chat session with therapist:* The day before the second consult, participants are asked to schedule a chat session with their therapist. This session takes place during the week following the second consult. The session is 20 min long. Participants are encouraged to ask questions about the exercises or comment on the consults so far. The therapist can also go into more detail for personal advice on sleep hygiene or bedtime instructions.

(*continued*)

TABLE 1
(*Continued*)

Week	*Group Therapy*	*Internet Therapy*
3	*Sleep logs:* Similar to the previous week. *Feedback on homework:* Similar to the previous week. In this week's feedback, the importance is stressed to consistently apply these techniques even if results are not directly noticed. *Cognitive restructuring exercise, Part 1:* The mechanisms of dysfunctional cognitions are introduced and explained. The therapist goes through the steps of finding and changing a dysfunctional into a functional cognition, and presents a written schedule of steps. Participants rehearse these steps in subgroups with their own identified dysfunctional cognitions. They are instructed to practice these steps for the coming week at least once. *Homework:* Similar to previous weeks.	*Sleep logs:* Similar to the previous week. *Feedback on homework:* Similar to the previous week. In this week's feedback, the importance is stressed to consistently apply these techniques even if results are not directly noticed. *Cognitive restructuring exercise, Part 1:* The mechanisms of dysfunctional cognitions are introduced and explained. Participants see a film of a therapist going through the steps of finding and changing a dysfunctional into a functional cognition, and are presented with a written schedule of steps. They rehearse with one of three optional dysfunctional cognitions, and they complete a questionnaire going through the steps from a dysfunctional to a functional cognition. They are instructed to practice these steps for the coming week at least once with one of their own thoughts. *Homework:* Similar to previous weeks.
4	*Sleep logs:* Similar to previous weeks. *Feedback on homework:* Similar to previous weeks, including questions on the exercise for cognitive restructuring. *Sleep restriction revisited:* The importance of sleep efficiency and a method to calculate personal sleep efficiency are presented. The relation of TIB, total sleep time, and sleep hygiene and the personal bedtime instructions are explained. *Cognitive restructuring exercise, Part 2:* Participants discuss how the exercise with restructuring dysfunctional cognitions went the last week. The mechanisms of this exercise are explained once more. *Homework:* Similar to previous weeks.	*Sleep logs:* Similar to previous weeks. *Feedback on homework:* Similar to previous weeks, including questions on the exercise for cognitive restructuring. *Sleep restriction revisited:* The importance of sleep efficiency and a method to calculate personal sleep efficiency are presented. The relation of TIB, TST, and sleep hygiene and the personal bedtime instructions are explained. *Cognitive restructuring exercise, Part 2:* Participants see a movie about the same patient and therapist of last week, now talking about how the exercise with restructuring dysfunctional cognitions went the last week. The mechanisms of this exercise are explained once more. *Homework:* Similar to previous weeks.

(*continued*)

TABLE 1
(*Continued*)

Week	*Group Therapy*	*Internet Therapy*
5	*Sleep logs:* Similar to previous weeks. *Feedback on homework:* Similar to previous weeks. *Relapse prevention:* Therapists discuss the influence of peer pressure in changing or keeping old habits (e.g., going to bed late during the weekend, smoking, drinking, etc.). Participants do a role-playing exercise regarding how to deal with peer pressure. Furthermore, in a short outline, all possible instruments that are presented in the previous consults are presented and discussed, to choose from in case their sleep is disturbed. *Homework:* Similar to previous weeks.	*Sleep logs:* Similar to previous weeks. *Feedback on homework:* Similar to previous weeks. *Relapse prevention:* Participants receive an explanation and short film on the influence of peer pressure in changing or keeping old habits (e.g., going to bed late during the weekend, smoking, drinking, etc.). They are encouraged to identify situations in which peer pressure may influence, for instance, their sleep hygiene and to intend their new habits. Furthermore, in a short outline, all possible instruments that are presented in the previous consults are presented to choose from in case their sleep is disturbed. *Homework:* Similar to previous weeks.
6	*Sleep logs:* Similar to previous weeks. *Feedback on homework:* Similar to previous weeks. *Summary and relapse prevention:* All exercises are summarized, including explanations. A list of five questions "you can ask yourself" when sleep problems recur are presented, with recommended techniques to apply in every specific situation. *Evaluation:* Participants fill out a short questionnaire about the usefulness and helpfulness of all techniques presented in the consults, which is discussed. *Preview:* Therapists stress that participants can use any or all of the exercises they learned during the past 6 weeks. The place and time is announced for a "booster consult," taking place about 2 months after the sixth consult.	*Sleep logs:* Similar to previous weeks. *Feedback on homework:* Similar to previous weeks. *Summary and relapse prevention:* All exercises are summarized, including explanations. A list of five questions "you can ask yourself" when sleep problems recur are presented, with recommended techniques to apply in every specific situation. *Evaluation:* Participants are asked to comment on the usefulness and helpfulness of all techniques presented in the consults. *Preview:* The relapse prevention list, with five questions and steps, is presented, again stressing that participants can use any or all of the exercises they learned during the past 6 weeks. The time is announced for a "booster consult," taking place about 2 months after the sixth consult.

If the scores on these questionnaires met the inclusion criteria (see the Participants section), participants were invited for a face-to-face interview with a sleep therapist about their sleep complaints, bedtimes, sleep histories, sleep circumstances, complaints and medical histories, family histories of sleep, and secondary subjective complaints. They then received further information on the baseline measures and on the use of the actometer and online sleep logs. Parents received a short booklet explaining the trial and treatment, clarifying that their child can do the treatment independently, although, for some exercises, their support might be required (e.g., the restriction of time in bed).

Statistical Analysis

Data from the actigraphy, sleep logs, and questionnaires were analyzed using multilevel regression analysis in which repeated measures were considered as nested within participants. With actigraphy and sleep log measures that were taken each day of the week, we distinguished between nights before school days and nights before free days to account for associated differences in sleep behaviors. Free days were weekends (Saturday and Sunday), public holidays, and dates where participants commented in their sleep logs that they were free. Multilevel regression analysis allows inclusion of participants with missing data at one or more measurement occasions (Snijders & Bosker, 1999), so all participants who provided baseline measurements were included in the analyses. All models included an intercept representing the mean score of group therapy participants at baseline and regression coefficients representing differences between Internet therapy and group therapy, differences between free nights and school nights, differences between randomized and nonrandomized participants within the Internet condition, differences between posttreatment and baseline, differences between follow up and posttreatment, and effects of the control variables age and gender. Age, gender, and cohort (randomized vs. nonrandomized participants within the Internet condition) showed no significant differential effects on sleep outcomes from actigraphy, sleep logs, and questionnaires, so we reran the models without these three variables. To investigate the differential effects of condition (Internet or group therapy) and type of night (school or free) on sleep behaviors, we also included regression coefficients for interaction effects of Condition × Time and Type of Night × Time. As we found no significant differential effects of condition on sleep behaviors measured through questionnaires (i.e., no significant interactions of time and condition), we reran these analyses with models that only included the time variables as predictors. All predictor and outcome variables have been standardized, so we can interpret the β coefficients as Cohen's *d* effect sizes (ESs), with .20, .50, and .80 indicating small, medium, and large ESs, respectively (Cohen, 1988). As the independent variables were coded binary (0, 1), separate ESs for both conditions can be deduced from ESs for the main effect and ESs for interaction efforts. ESs for the group condition are the coefficients for the main effect. When there is a significant interaction of Time × Condition, the ES for the Internet condition is the addition of the ES of the group condition and the ES of the interaction. If there is no significant interaction of Time × Condition, the ES of the Internet condition is similar to the group condition. (For an example of this calculation, see the description for SE from actigraphy measures in the Results section.)

TABLE 2
Demographic Variables and Insomnia Symptoms at Intake

Variable	*Group Therapy*[a]	*Internet Therapy*[a]
Girls (*n*)	10	11
Age (in years): *M* (*SD*)	14.9 (1.9)	14.3 (1.3)
Number of participants		
SOL > 30 min	13	13
WASO > 30 min	9	9
Nights per week that sleep problems occur > 3	13	13
Months sleep problems exist > 3	13	11
Significant impairment in daily life	11	13
Meet described *DSM–V* insomnia criteria	11	11

Note. SOL = sleep onset latency; WASO = wake after sleep onset.
[a]$N = 13$.

RESULTS

Baseline Characteristics

Table 3 shows that there were hardly any differences between the two groups in demographic variables and insomnia symptoms at intake. In both groups, two participants did not fully meet the described *DSM–V* (American Psychiatric Association, 2010) criteria for primary insomnia either because of lack of clinically significant impairment in daily life or because the sleep problems were not present for more than 3 months yet. However, after inclusion in the study, at baseline measurements, there appeared to be differences between the two groups on several actigraphy and sleep log variables. (For further details of these results, see the Sleep Outcomes section.)

Feasibility of CBT–i for Adolescents

In the Internet condition, all 13 participants opened all the consults, 11 of whom completed all pages of each consult and answered all evaluation questions about the exercises of the previous week, each week. Two participants started all consults but completed only four, and one of them did not answer any of the evaluation questions. Nine participants gave evaluation feedback at the end of treatment, of which one was a question and eight were all comments that the program had helped, mentioning several of the modules, of which bedtime instructions were mentioned by five of the eight participants as very helpful.

In the group condition, all 13 participants completed all of the consults. In the evaluation questionnaires, 10 participants mentioned the personal bedtime instructions as being very helpful, and seven mentioned the body scan relaxation exercise as being helpful. Four participants mentioned that the exercise for cognitive restructuring did not help or apply to them, but four others said it was helpful.

TABLE 3
Means and Standard Deviations of Actigraphy, Sleep Logs, and Questionnaires for Group Therapy and Internet Therapy at Baseline (T0), Posttreatment (T1), and at Follow Up (T2)

		Group Therapy			*Internet Therapy*		
Variable	*Night Type*	*T0 M (SD)*	*T1 M (SD)*	*T2 M (SD)*	*T0 M (SD)*	*T1 M (SD)*	*T2 M (SD)*
Actigraphy							
SE (%)	School	75.1 (7.5)	80.0 (7.8)	82.0 (7.5)	81.4 (5.4)	81.8 (6.3)	84.1 (5.1)
	Free	77.3 (6.9)	81.0 (6.2)	82.5 (10.4)	79.0 (7.4)	80.9 (5.5)	85.4 (5.1)
TST (hours)	School	6.8 (0.8)	6.8 (1.2)	6.8 (1.0)	7.3 (0.9)	7.5 (0.9)	6.9 (0.5)
	Free	7.6 (1.0)	7.3 (1.2)	7.2 (1.4)	7.6 (0.9)	7.4 (0.7)	7.5 (0.8)
SOL (minutes)	School	49.0 (33.3)	24.0 (22.3)	16.8 (14.0)	15.9 (15.3)	14.4 (17.3)	13.1 (10.9)
	Free	27.4 (18.7)	21.6 (18.3)	16.1 (13.7)	26.1 (29.5)	17.1 (15.4)	3.8 (3.0)
WASO (minutes)	School	84.5 (38.0)	74.5 (35.2)	69.7 (34.5)	79.7 (30.6)	82.8 (35.2)	63.2 (24.8)
	Free	100.1 (38.9)	82.1 (39.7)	70.6 (36.1)	93.1 (37.4)	81.4 (35.9)	73.9 (31.0)
TIB (hours)	School	9.1 (0.9)	8.5 (1.3)	8.3 (0.8)	9.0 (1.0)	9.2 (0.9)	8.2 (0.4)
	Free	9.9 (1.0)	9.1 (1.4)	8.7 (1.2)	9.8 (1.1)	9.1 (0.8)	8.8 (1.1)
Sleep logs							
SE (%)	School	76.4 (14.6)	89.2 (6.3)	89.6 (5.5)	87.4 (8.9)	92.8 (2.3)	94.4 (3.0)
	Free	81.8 (16.0)	88.5 (6.2)	88.2 (6.8)	86.6 (9.8)	92.8 (6.7)	92.7 (4.3)
TST (hours)	School	6.9 (1.5)	7.1 (1.1)	7.6 (1.0)	7.7 (1.0)	8.0 (0.7)	8.0 (0.6)
	Free	8.2 (1.8)	8.8 (1.2)	8.6 (1.4)	8.9 (1.6)	8.9 (1.3)	8.5 (1.4)
SOL (minutes)	School	68.4 (38.0)	34.8 (17.7)	35.1 (24.4)	44.3 (42.2)	21.9 (10.9)	16.2 (8.0)
	Free	41.5 (40.4)	33.3 (16.3)	33.9 (26.5)	30.6 (38.1)	19.4 (26.2)	16.1 (10.5)
WASO (minutes)	School	34.5 (38.9)	3.8 (7.2)	6.8 (11.2)	8.3 (14.2)	1.0 (2.8)	3.3 (8.0)
	Free	25.0 (38.8)	5.4 (9.2)	7.2 (12.6)	11.5 (20.4)	5.1 (8.9)	1.7 (5.1)
TIB (hours)	School	9.0 (0.9)	8.0 (1.1)	8.4 (1.0)	8.9 (0.9)	8.6 (0.7)	8.5 (0.6)
	Free	10.0 (1.2)	10.0 (1.3)	9.8 (1.4)	10.3 (1.5)	9.5 (1.1)	9.1 (1.5)
Questionnaires							
Insomnia symptoms (HSDQ–I)		3.3 (0.6)	3.0 (0.8)	2.8 (0.7)	3.1 (0.6)	2.5 (0.8)	2.5 (0.8)
Shortage of sleep (CSRQ)		13.8 (2.1)	12.9 (2.6)	12.1 (2.7)	13.5 (2.7)	11.6 (2.6)	10.6 (2.8)
Irritation (CSRQ)		8.7 (2.5)	8.4 (2.2)	7.0 (1.9)	7.8 (2.3)	7.3 (2.0)	6.3 (1.4)
Loss of energy (CSRQ)		10.5 (2.2)	9.6 (2.5)	10.0 (2.4)	10.0 (2.3)	8.1 (2.1)	8.6 (1.8)
Sleepiness (CSRQ)		8.3 (2.5)	7.9 (2.5)	7.6 (2.4)	8.2 (2.2)	7.3 (2.3)	7.0 (1.5)
Total (CSRQ)		41.3 (6.5)	38.8 (7.3)	36.8 (6.7)	39.5 (7.9)	34.3 (6.6)	32.5 (5.3)

Note. Measures from actigraphy and sleep logs were divided by nights before schooldays and nights before free days. SE = sleep efficiency; TST = total sleep time; SOL = sleep onset latency; WASO = wake after sleep onset; TIB = time in bed; HSDQ–I = Holland Sleep Disorder Questionnaire-Insomnia scale; CSRQ = Chronic Sleep Reduction Questionnaire.

Means and standard deviations of all dependent variables from the actigraphy, sleep logs, and questionnaires are presented in Table 4. Results from the multilevel regression analyses are presented in Table 2.

Sleep Outcomes

Actigraphy measures. The data from Table 2 show that the Internet condition had a significantly higher SE than the group condition at baseline ($\beta = 0.64$; medium ES). SE significantly increased from baseline to posttreatment ($\beta = 0.69$; large ES). A significant interaction of Time × Condition (Posttreatment × Internet Therapy; $\beta = -0.49$; medium ES), however, showed there was less improvement in SE at posttreatment for the Internet condition, for which the ES can be calculated by $\beta = 0.69 + -0.49 = 0.20$ (small ES). Table 4 shows that for the group condition, the increase of SE on school nights was 4.9%, and for the Internet

TABLE 4
Parameter Estimates for Measurements at Baseline, Posttreatment, and 2 Months Follow Up; Condition (Internet vs. Group Therapy); and Type of Night (Free vs. School) for all Variables From Actigraphy, Sleep Logs, and Questionnaires

	SE			*TST*			*SOL*			*WASO*			*TIB*		
Variable	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
Actigraphy															
Internet (vs. group) therapy	0.64	0.27	< .05	0.37	0.24	.12	−0.94	0.17	< .001	−0.16	0.31	.60	−0.07	0.21	.75
Free (vs. school) nights	0.01	0.11	.91	0.52	0.14	< .001	−0.29	0.15	.05	0.38	0.11	< .001	0.70	0.14	< .001
Posttreatment (vs. baseline)	0.69	0.12	< .001	0.04	0.15	.81	−0.97	0.16	< .001	−0.22	0.12	.06	−0.49	0.15	< .01
Follow up (vs. posttreatment)	0.06	0.14	.64	−0.16	0.17	.35	−0.19	0.18	.28	−0.04	0.13	.73	−0.26	0.17	.13
Posttreatment × Internet Therapy	−0.49	0.16	< .01	0.06	0.20	.78	0.66	0.21	< .01	0.23	0.16	.15	0.45	0.20	< .05
Posttreatment × Free Nights	−0.06	0.17	.73	−0.27	0.21	.21	0.37	0.22	.10	−0.29	0.16	.07	−0.35	0.21	.10
Follow Up × Internet Therapy	0.23	0.19	.23	−0.23	0.23	.31	0.07	0.24	.75	−0.28	0.18	.12	−0.37	0.23	.11
Follow Up × Free Nights	0.10	0.20	.60	0.28	0.24	.25	−0.19	0.25	.45	0.09	0.18	.62	0.21	0.24	.39
Sleep logs															
Internet (vs. group) therapy	0.84	0.19	< .001	0.56	0.20	< .01	−0.58	0.21	< .01	−0.97	0.17	< .001	0.03	0.20	.90
Free (vs. school) nights	0.14	0.12	.25	0.80	0.12	< .001	−0.55	0.12	< .001	−0.10	0.13	.46	0.95	0.12	< .001
Posttreatment (vs. baseline)	1.14	0.16	< .001	0.38	0.16	< .05	−0.98	0.16	< .001	−1.34	0.17	< .001	−0.44	0.15	< .01
Follow up (vs. posttreatment)	0.11	0.17	.52	0.19	0.17	.25	−0.03	0.17	.84	0.18	0.18	.31	0.14	0.16	.38
Posttreatment × Internet Therapy	−0.45	0.17	< .01	−0.31	0.17	.07	0.14	0.17	.41	0.92	0.18	< .001	−0.06	0.16	.73
Posttreatment × Free Nights	−0.26	0.18	.16	−0.07	0.18	.70	0.62	0.18	< .01	0.29	0.19	.13	0.07	0.17	.71
Follow Up × Internet Therapy	−0.04	0.20	.82	−0.10	0.20	.62	0.02	0.20	.93	−0.07	0.21	.73	−0.05	0.19	.80
Follow Up × Free Nights	−0.02	0.21	.94	−0.12	0.21	.56	−0.12	0.21	.56	−0.25	0.22	.27	−0.17	0.20	.40

	HSDQ–I			*CSRQ Total*			*CSRQ Shortage of Sleep*			*CSRQ Irritation*			*CSRQ Loss of Energy*			*CSRQ Sleepiness*		
Variable	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
Questionnaires																		
Posttreatment (vs. baseline)	−0.61	0.16	< .01	−0.55	0.15	< .01	−0.59	0.14	< .001	−0.17	0.18	.35	−0.62	0.17	< .01	−0.28	0.14	.05
Follow up (vs. posttreatment)	−0.31	0.13	< .05	−0.32	0.14	< .05	−0.36	0.22	.12	−0.51	0.14	< .01	0.07	0.11	.56	−0.18	0.12	.16

Note. All outcome variables have been standardized so that beta coefficients can be interpreted as Cohen's *d* effect sizes, with .20, .50, and .80 indicating small, medium, and large effect sizes, respectively (Cohen, 1988). SE = sleep efficiency; TST = total sleep time; SOL = sleep onset latency; WASO = wake after sleep onset; TIB = time in bed; HSDQ–I = Holland Sleep Disorder Questionnaire-Insomnia scale; CSRQ = Chronic Sleep Reduction Questionnaire.

condition was 0.4%, but where the group condition started out at baseline with an SE of 75.1% ($SD = 7.5$), the Internet condition had an SE of 81.4% ($SD = 8.9$) at baseline, leaving less room for an increase of SE.

Contrary to expectations, TST did not significantly improve at posttreatment. There was, however, as expected, significantly more TST on free nights than on school nights ($\beta = 0.52$; medium ES). We found no significant interactions between time and condition.

The Internet condition had a significantly lower average SOL at baseline than the group condition ($\beta = -0.94$; large ES). SOL had significantly decreased at posttreatment for the group condition ($\beta = -0.97$; large ES), and the significant interaction of time and condition shows there was less improvement of SOL at posttreatment for the Internet condition, with an ES of $\beta = -0.97 + 0.66 = -0.31$ (small ES).

There was significantly more WASO on free nights than on school nights ($\beta = 0.38$, medium ES), but no significant difference between groups, and no interaction between time and condition occurred.

There was significantly more TIB on free nights ($\beta = 0.70$; medium ES). At posttreatment, TIB significantly decreased ($\beta = -0.49$; medium ES), but a significant interaction between time and condition ($\beta = 0.45$; medium ES) shows there was no decrease of TIB for the Internet condition ($\beta = -0.49 + 0.45 = 0.04$).

Summarizing, the results from actigraphy measures show that in both Internet and group therapy, all the sleep variables—with the exception of TST and TIB—significantly improved posttreatment and at follow up. However, most sleep variables showed better scores for the Internet group at baseline; and, accordingly, ESs for improvement were greater for the group therapy compared to the Internet therapy. TIB significantly decreased in the group condition, indicating the exercise restriction of TIB had an effect for this group. In the Internet condition, there was no decrease of TIB.

Sleep log measures. Similar to actigraphy measures, the Internet condition had a significantly higher SE at baseline than the group condition ($\beta = 0.84$; large ES). At posttreatment, SE had significantly increased ($\beta = 1.14$; large ES), and the significant interaction of time and condition ($\beta = -0.45$; small ES) showed less improvement for the Internet condition ($\beta = 1.14 + -0.45 = 0.69$; large ES). The data from Table 4 show that for the group condition, SE on school nights increased from 76.4% ($SD = 14.6$) at baseline to 89.2% ($SD = 6.3$) at posttreatment. For the Internet condition, SE on school nights increased from 87.4% ($SD = 8.9$) at baseline to 92.8% ($SD = 2.3$) at posttreatment.

In contrast to the results from the actigraphy, results from the sleep logs showed the Internet condition had significantly more TST at baseline ($\beta = 0.56$; medium ES). Also contrary to actigraphy measures, sleep logs showed a significant increase of TST at posttreatment ($\beta = 0.38$; medium ES). The descriptives in Table 4 show that TST on school nights for the group condition increased from 6.9 hr ($SD = 1.5$) at baseline to 7.6 hr ($SD = 1.0$) at follow up. For the Internet condition, TST on school nights increased from 7.7 hr ($SD = 1.0$) at baseline to 8.0 hr ($SD = 0.6$) at follow up. There was significantly more TST on free nights ($\beta = 0.80$; large ES) but there was no interaction between time and type of night, indicating no differential effects of treatment on TST for free and school nights.

There was a significant difference in SOL between the groups at baseline ($\beta = -0.58$; medium ES), and there was significantly shorter SOL on free nights ($\beta = -0.55$; medium

ES). SOL had significantly decreased at posttreatment ($\beta = -0.98$; large ES), and there was no further significant change in SOL at follow up. There was no interaction between time and condition, indicating a similar decrease of SOL for both groups. A significant interaction of time and type of night showed less decrease of SOL for free nights ($\beta = 0.62$; medium ES) at posttreatment.

At baseline, there was significantly less WASO in the Internet condition ($\beta = -0.97$; large ES), but no difference between free or school nights. WASO had significantly decreased at posttreatment ($\beta = -1.34$; large ES), but a significant interaction between time and condition ($\beta = 0.92$; large ES) shows less decrease of WASO at posttreatment for the Internet condition ($\beta = -1.34 + 0.92 = 0.42$; medium ES).

There was a significant and shorter overall TIB at posttreatment ($\beta = -0.44$; medium ES). On free nights, TIB was significantly longer ($\beta = 0.95$; large ES), but there was no significant interaction of time and type of night, nor was there an interaction of time and condition, indicating similar effects for both conditions irrespective of type of night.

Summarizing, similar to the results from actigraphy measures, the sleep log measures also show that in both Internet and group therapy, all the sleep variables significantly improved posttreatment and at follow up. Furthermore, most sleep variables showed better scores for the Internet group at baseline; and, accordingly, ESs for improvement were greater for the group therapy, compared to the Internet therapy. However, in contrast to the actigraphy measures, the sleep log measures also showed an improvement in TST at posttreatment and follow up.

Questionnaires. There was a significant improvement of the score for the Insomnia scale of the HSDQ at posttreatment ($\beta = -0.61$; medium ES); and at follow up, this score improved further ($\beta = -0.31$; small ES). The overall CSRQ score also significantly improved at posttreatment ($\beta = -0.55$; medium ES), and improved further at follow up ($\beta = -0.32$; small ES). The scores on the *shortage of sleep* and *loss of energy* subscales from the CSRQ had significantly improved at posttreatment ($\beta = -0.59$ and -0.62, respectively; both medium ES), but did not improve further at follow up. Sleepiness improved from baseline to posttreatment ($\beta = 0.28$, $p = .05$; small ES). The *irritation* subscale from the CSRQ had not changed at posttreatment, but had significantly improved at follow up ($\beta = -0.51$; medium ES).

DISCUSSION

Insomnia is a serious sleep disturbance that can have severe disruptive effects on daytime functioning and health, also in youth. The main purpose of this pilot study was to assess feasibility of CBT–i in a group of adolescents and examine efficacy. Furthermore, this study aimed to investigate the application of CBT–i through an online treatment Web site. Results indicate that six sessions of CBT–i in both group and Internet settings has strong alleviating effects on disturbances of sleep parameters, insomnia complaints, and symptoms of chronic sleep reduction both in the short and in the longer terms. These results are comparable to results from research with adults (Espie et al., 2012; Lancee et al., 2012; Ritterband et al., 2009; Vincent & Lewycky, 2009).

Most sleep variables as measured with both actigraphy and sleep logs improved, showing increased SE, shorter sleep latency periods, and less WASO with medium to large ESs. However,

where sleep logs showed a considerable improvement of TST for school nights in both groups, actigraphy measures indicated that TST did not increase during or after the treatment. This was expected during treatment because of sleep restriction in which participants limit their TIB to induce sleep drive and reduce time awake during the night. However, at the conclusion of the treatment, TST might increase. A possible explanation for TST not increasing is that participants in both conditions, as was advised, continued to use sleep restrictions if they felt they were needed. Sleep restrictions mostly resulted in later bedtimes, as restricting bedtime by going to bed later is easier to maintain than getting up earlier in the morning, especially for adolescents with a preference for later rise times. Also, going to bed later is generally seen by adolescents as a positive thing because it is associated with freedom and being grown up. Therefore, once participants were used to these bedtimes, they may have been reluctant, after treatment was terminated, to change them.

There is a discrepancy between TST from actigraphy and sleep log measures, which may be the result of sleep-state misperception (Mercer, Bootzin, & Lack, 2002). This difference between TST from sleep logs and actigraphy may also be due to actigraphy algorithms scoring epochs as wake (WASO), whereas the individual perceives it as sleep, possibly because of increased sleep motor activity in adolescents (Short, Gradisar, Lack, Wright, & Carskadon, 2012). Compared to WASO from the sleep logs, the WASO from actigraphy was extremely high in both groups. This problem with actigraphically scored WASO may have overestimated baseline WASO, but it may also have suppressed any possible decrease in WASO or increase of TST after treatment. So far, explanations in the literature have been inconclusive on this issue of high scores of WASO from actigraphy in adolescents. In a recent review, Meltzer, Montgomery-Downs, Insana, and Walsh (2012) concluded that actigraphy use in pediatric populations, including adolescents, show high sensitivity but somewhat low specificity in comparison to PSG. This means actigraphy scores are accurately indicating sleep that is determined by PSG as sleep (sensitivity), but are a somewhat less accurate indication of PSG-determined wake as wake (i.e., overestimating sleep; specificity). If that were the case in our sample, the WASO scores from actigraphy are an underestimation compared to the expected scores from PSG, and actual WASO should be even higher than what we found. However, in another recent study, Scholle et al. (2011) reported normative values from PSG for sleep parameters in pediatric populations. From the values reported in that study, it can be deduced that for the participants in our study, a WASO of 21.1 min to 34.3 min could be expected, which is much less than the WASO we found with actigraphy (between 79.7 min and 101.0 min at baseline). More research is needed to clarify these issues.

In contrast to TST, SE improved, and there was shorter SOL and WASO. These improvements were corroborated by the improvement of symptoms of chronic sleep reduction and insomnia, which may indicate that, perhaps more so than TST, the sleep quality—either subjectively shown by improved scores on rating scales or objectively measured with actigraphy—is an important factor in adolescents' sleep. Although objective TST did not increase, the results from the CSRQ indicate that participants' levels of chronic sleep reduction were reduced after treatment. The results from the Insomnia scale of the HSDQ showed a similar improvement, with reduced severity of insomnia symptoms after treatment. The irritation subscale from the CSRQ, however, showed no improvement directly after treatment; but at follow up, this had significantly dropped. This delayed effect on irritation may be due to a delayed effect of the exercises of the treatment.

The effects of treatment, especially the decrease of SOL in actigraphy measures, seemed larger for the group condition, but this is mostly due to a much shorter SOL at baseline for the Internet condition, which allowed them limited room for improvement in comparison to the group condition. The sleep logs, however, did not show the same difference of SOL between groups at baseline, and SOL decreased on a comparable level for both groups. All other measures mostly show similar patterns of change for both groups, but group sizes were small, and possible differences between groups may have been missed by lack of statistical power.

Although, overall, these results show medium to large improvements in both subjective and objective sleep variables, sleep quality, and insomnia complaints, the study has several limitations. First, we did not have a control group of participants on a waiting list or placebo or a psychoeducation treatment. Second, although the content of the CBT–i protocol of treatment for both group and Internet conditions was largely similar, the mode of application may have resulted in two different treatments altogether. For example, in Internet therapy, a client has more control over the amount of time and attention spent on each exercise. Furthermore, the interactions in a group are inherently different from interactions between therapist and client in an online setting, and studies show there is a strong relation between input from a therapist and efficacy of Internet treatments (Palmqvist et al., 2007). We used an online CBT–i protocol with minimal, but continuous, therapist input in the consults and the 15-min chat session. With more statistical power, these differences between conditions can be included in the analyses and in the models for efficacy. The results in this study, however, indicate that treatment effects are largely similar for both conditions. Third, the power of this pilot study was too low to detect small ES differences between conditions. Results showed there was a large baseline difference between the two conditions, especially in SOL. This makes some of the results—most specifically, the interaction for Time × Condition for SOL—difficult to interpret. In separate analyses, we tested whether this baseline difference can be attributed to the fact that about one-half of the participants from the Internet condition were not randomized, but we found no baseline differences between randomized and nonrandomized participants. Nevertheless, the quasi-random design in which time of intervention was not systematically randomized is a clear limitation of this pilot study. Finally, as noted before, the data from actigraphy and sleep log measures show some inconsistency—most notably, the very large WASO from measures of the actigraphy (between 79.7 min and 101.0 min at baseline) and much lower values from sleep log measures (between 8.3 min and 23.5 min at baseline). This study showed a decrease of WASO after treatment in sleep logs, most likely indicating an improvement of insomnia symptoms due to treatment. The issue of high WASO in actigraphy measures of adolescents needs further research.

This study included CBT–i Internet treatment and group treatment for adolescents and, as such, contributes to both knowledge of efficacy of CBT–i for adolescents and feasibility of Internet treatments for this age group. As indicated before, adolescents are reluctant to seek help at public mental health services for psychological problems, and this study shows the Internet may well provide an added resource to reach this group. Although some participants in the Internet condition did not complete all the modules, most participants from both conditions indicated several exercises as being helpful, of which personal bedtime instructions were mentioned most often. The overall picture shows that adolescents may profit from CBT–i treatment, either online or in a group. To examine which exercises may be particularly helpful,

we recommend further studies into CBT–i for adolescents, with larger numbers of participants in a randomized, controlled design. More insight into the effects of specific exercises from the CBT–i protocol is necessary to distinguish effects in different conditions and at different stages of the treatment. Furthermore, insights into the effects of the separate CBT–i exercises and relations to the type and amount of therapist input, and to client characteristics like age, gender, and severity of insomnia complaints and chronic sleep reduction, can help optimize CBT–i for adolescents.

To summarize, this is the first study into CBT–i for adolescents comparing treatment in online and group settings, which shows both conditions can have strong and comparable alleviating effects on objective and subjective insomnia symptoms and complaints.

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