MASTER THESIS

Body Scan as part of Cognitive Behavioural Treatment for Insomnia:

Correlation between the amount of practice and treatment outcomes

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January 2020

UNIVERSITY OF TWENTE.

Abstract

Background: Insomnia is ranked as the most common sleep disorder among adolescents and recent studies even indicate an increase in the prevalence of insomnia. The most recommended and promising treatment for insomnia in adults and adolescents is the Cognitive Behavioural Therapy for Insomnia (CBTI). This study focuses on the CBTI element mindfulness-based relaxation training (MBSR) in the form of Body Scan exercises. Body Scan itself has been proven to be an effective treatment for insomnia but there is a lack of research on which added value Body Scan has as part of a CBTI treatment for adolescents.

Purpose: The purpose is to investigate, if engagement in self-help online relaxation exercises as part of a CBTI treatment has positive effects on sleep-related outcome variables (HSDQi and actigraphy) of the participants.

Method: This study was part of a larger randomized controlled trial (RCT) and only focuses on the condition Internet Treatment (IT). Participants were 51 adolescents (mean age M= 15.4, SD= 1.7) divided into two groups 'Body Scan practice' and 'No Body Scan practice' based on self-report use of body scan during their six weeks long CBTI treatment. At baseline, post-treatment and 2-months follow-up symptoms of insomnia (HSDQi) and sleep parameters from actigraphy (Sleep onset latency, wake after sleep onset, total sleep time and sleep efficiency) were measured. The two conditions were compared using repeated measures ANOVA.

Results: The results showed that engagement in Body Scan had a positive effect on the sleep outcome variables, with a significant difference between the two conditions and interaction effect of the condition and the treatment in the time, participants were wake after sleep onset (WASO). Other significant differences between the conditions or interaction effects could not be found.

Conclusion: Body Scan practice during an online-based CBTI for adolescents can have a positive effect on the sleep outcome variable WASO and may lead to a more positive trend in improvement of insomnia symptoms than no Body Scan practice. The assignment of the participants to one of the two conditions was not randomly done but via a self-report question, which enlarged the scope for other possible explanations of the results. For future research, a random assignment is suggested to minimize the scope for other possible explanations.

Contents

Introduction

Insomnia

Many young adults, especially college students, suffer from stress and therefore are susceptible to the consequences of stress-related disturbances, like sleep-disturbances. Academic pressure and poor sleep habits often result in unsatisfying sleep in general, more sleepiness, energy loss, daytime fatigue and in the diagnostic of insomnia (De Bruin, Bögels, Oort, & Meijer, 2015). Insomnia is already ranked as the most common sleep disorder among adolescents with a point prevalence between 7.8% and 23.8% and recent studies even indicate an increase in the prevalence of insomnia (Chung, Kan, & Yeung, 2014; Hysing, Pallesen, Stormark, Lundervold, & Sivertsen, 2013; Johnson, Roth, Schultz, et al., 2006; Riemann et al., 2017), which is alarming, because sleep is seen as one of the most important preconditions of adolescent development and therefore insomnia constitutes one of the major public health problems (De Bruin, Oort, Bögels, & Meijer, 2014).

Insomnia is defined as a predominant complaint of dissatisfaction with sleep quantity or quality, accompanied by significant daytime impairment, three or more days per week, for at least three months, despite adequate opportunity to sleep (APA, 2013). In detail, the complaints of this serious sleep disturbance include difficulties falling asleep, staying asleep or not feeling rested after getting up and this consequently has severe disruptive effects on daytime functioning and health, like inattention and conduct problems, drug and alcohol abuse and impaired academic performance (De Bruin et al., 2014; Johnson, Roth, & Breslau, 2006; Roberts & Duong, 2013; Dahl & Lewin, 2002; Meijer, Reitz, Dekovic, van den Wittenberger, & Stoel, 2010; Curcio, Ferrara, & De Gennaro, 2006; Dewald, Meijer, Oort, Kerkhof, & Bogels, 2010). Insomnia is seen as a mental disorder per se (Primary Insomnia (PI)) and can be targeted by an intervention in itself, but it often occurs comorbid with other psychopathological disorders, like depression, anxiety and attention deficit hyperactivity disorder and additionally is sometimes linked with medical illness including hypertension, heart disease and diabetes (De Bruin et al., 2018; Baglioni, Battagliese, Feige, Spiegelhalder, Nissen,Voderholzer, Lombardo, & Riemann, 2011; Phillips & Mannino, 2007). The lifetime prevalence of insomnia, as defined in the DSM-IV in adolescents aged 13 to 16, is about 10.7% and there is evidence, that insomnia is a highly chronic disorder even at such a young age (APA, 1994; De Bruin et al., 2018).

There are many different theories about how insomnia is triggered and maintained over a longer period. One of them, especially interesting for this study, is the hyperarousal model of insomnia. This model states that increased cognitive, emotional and physiological arousal levels are both predisposing and perpetuating factors for sleep disturbance and daytime dysfunction (Perlis, Giles, Mendelson, Bootzin, & Wyatt, 1997). Saper, Scammell and Lu (2005) state, that neurobiologically, hyperarousal may be driven by a dominance of arousal-generating brain areas relative to sleep-inducing brain areas. There is evidence that patients with insomnia show an increased level of physical arousal during their sleep, such as an elevation in cortisol, daytime body temperature and increased alertness on sleep latency tests (Ong & Smith, 2017). Cognitive and emotional arousal levels could be seen in greater levels of pre-sleep cognitive activity, a more negative tone of sleep-related cognitions and more dysfunctional sleep-related cognitions (Ong & Smith, 2017). These cognitive and emotional arousal levels (e.g. worry and rumination), are seen to be relevant in the development and maintenance of insomnia (Riemann et al., 2017).

The consequences of insomnia and its high level of arousal can be, as already noted above, serious for physical and mental health, and social and cognitive functioning of the patients as well as for their social and academic environment. Patients report to be lonelier, less satisfied with life, less active in work and social activities, and have a higher risk of developing other psychopathological disorders, like depression, anxiety, drug and alcohol abuse (Bixler, Kales, Soldatos, Kales & Healey, 1979; Ford & Kamerow, 1989; Kales et al., 1984; Mellinger, Balter & Uhlenhuth, 1985). There also is evidence that sleep disturbances in adolescents may precede ADHD symptoms, leading to a possible onset of ADHD (Owens et al., 2013; Gruber, 2009; Millman, 2005; Chervin, Dillon, Bassetti, Ganocsy, & Pituch, 1997). Especially adolescents with academic pressure suffer from the negatively impacted work performance, reduced productivity and higher absent rates, occurring through the sleep problems. This, in turn, can cause higher cognitive arousal levels in form of rumination during the day and before going to sleep, resulting in less sleep or more unsatisfying sleep in general, which may lead to a self-perpetuating vicious cycle of not sleeping satisfactory, caused by and causing high arousal levels. Therefore, it is important to further investigate the possible treatment options for insomnia, in order to be able to help und support people with insomnia the best way possible and prevent a greater negative impact on their lives and their environment.

Currently, the most recommended and promising form of treatment for insomnia is the so-called Cognitive Behavioural Therapy for Insomnia (CBTI) (De Bruin et al., 2015, Taylor & Pruiksma, 2014). It has been proven to be effective in adults and adolescents as well, also in the long-term (De Bruin et al., 2015). Additionally, there is evidence that CBTI is as effective in face-to-face treatment as in online-based forms of this treatment (De Bruin et al., 2015). One of the most interesting aspects of CBTI for this study, is the component addressing psychophysiological arousal through focusing on psychological and physiological relaxation (Ong & Smith, 2017).

Treatment of Insomnia

Cognitive Behavioural Therapy for Insomnia is a non-pharmacological treatment, which consists of several components addressing the different aspects of insomnia, namely stimulus control therapy, relaxation training, sleep restriction, sleep hygiene education, psycho-education and cognitive therapy (De Bruin et al., 2018; Mitchell, Gehrmann, Perlis, & Umscheid, 2012). All these techniques are effective interventions, individually and combined, and recommended as therapy for insomnia (De Bruin et al., 2018; De Bruin et al., 2014; Taylor & Pruiksma, 2014). Taylor and Pruiksma (2014) state, that techniques with the strongest empirical support in primary insomnia are stimulus control therapy, sleep restriction, relaxation training and cognitive therapy. The goal of CBTI is to target maintaining factors of insomnia, like dysregulation of sleep drive, sleep-related negative thoughts and emotions, and sleep interfering behaviours, in order to improve and restore the subjective sleep quality and quantity (Mitchell et al., 2012). CBTI treatment is delivered in four to eight weekly sessions, each about 30-60 minutes long.

There are several researches, reviews and meta-analyses concluding, that CBTI is an effective treatment for primary and comorbid insomnia in adults and adolescents, as well face-to-face as online based and that it is at least as effective as pharmacotherapy (De Bruin et al., 2018; De Bruin et al., 2014; Van Straten et al., 2017). Edinger, Wohlgemuth, Radtke, Marhs and Quillian (2001) tested the efficacy of CBTI compared with both a pure relaxation training and a placebo therapy and found that CBTI produced larger improvements in the majority of outcome measures, than did relaxation training or the placebo treatment. They concluded, that CBTI leads to clinically significant sleep improvements, which are also present in the long-term. These findings can also be found in the research of Kaldo et al. (2015). They evaluated, if internet-delivered CBTI with brief therapist support is more effective than an active control treatment and found, that the CBTI treatment was significantly more effective than the control treatment and that the improvements remain stable over one year after the treatment (Kaldo et al., 2015). Furthermore, van Straten et al.

(2017) concluded in their meta-analyses on 87 studies, that CBTI is an effective treatment for insomnia, either its components or the full package.

The component of CBTI, that is focused on in this study, is relaxation training. One part of relaxation training is the so-called mindfulness-based therapy (MBT), which uses the practice of meditation to train non-judgemental, present-moment awareness of the own thoughts, feelings and bodily sensations (Ong & Smith, 2017). Thus, with MBT, patients are taught to intentionally pay attention to the present experience with an accepting and non-judgemental attitude. The aim of this attitude is, to reduce emotional distress by changing the relationship to the thoughts and feelings the patient has (Ong & Smith, 2017). In the case of insomnia, negative sleep-related cognitions and feelings are targeted, in order to counteract cognitive, emotional and physical arousal before sleep. There is evidence, that neurobiologically, mindfulness meditation can be associated with changes in several brain regions, including those related to emotion regulation (e.g., prefrontal cortex) and self-referential processing (e.g., default mode network) (Ong & Smith, 2017). The mechanisms of mindfulness techniques are reported to have an effect on attention regulation, body awareness, emotion regulation and changes in self-perspective, which all promote well-being (Ong & Smith, 2017). In the context of insomnia and its hyperarousal model, mindfulness is used in order to counteract sleep-related stress and arousal that emerges from the inability to sleep. Given the evidence for psychophysiological arousal, exercises based on Mindfulness Based Stress Reduction (MBSR), such as deep breathing, guided mental imagery or Body Scan, are recommended and used to reduce physical and cognitive arousal and to promote sleep (Ong & Smith, 2017).

Within this study, the MBSR technique Body Scan is used. This technique is a somatically oriented, attention focusing, non-action-based, non-goal-oriented practice and is described as a 'zone purification' of the body (Dreeben, Mamberg, & Salmon, 2013; Kabat-Zinn, 1990, p.87). It is described as 'affectionate, openhearted [and] interested' attention to the body (Kabat-Zinn, 2005, p.250) and practically consists of solely focusing on feelings inside the body, experiencing moment by moment (Kabat-Zinn & Kappen, 2010), aiming at reducing stress and increasing quality of life. Several researches found these effects (e.g. Hawley et al., 2014; Vettese, Toneatto, Stea, Nguyen, & Wang., 2009). These researches show that several negative cognitive mediators for psychopathology, including symptoms of insomnia (e.g. rumination, stress reactivity and experiential avoidance-factors) were positively affected by practicing Body Scan regularly. This can be adapted to the hyperarousal model of insomnia, regarding rumination and stress reactivity as high cognitive, emotional and also physiological arousal levels, which are aimed to be reduced by the Body Scan through assisting individuals in increasing acceptance of their current sleep state and highlighting the notion that sleep cannot be forced. Furthermore, there is evidence that the amount of time spent for practicing Body Scan is an indicator of its positive effects (Dreeben et al., 2013). Lengacher et al. (2009) concluded in their study, that Body Scan practice time was correlated with significant improvements in trait anxiety, depression, perceived stress, emotional well-being and mental health in breast cancer survivors. In the context of insomnia this can be linked to the symptoms, patients with insomnia show as well, such as perceived stress, low emotional well-being and depression.

Purpose of study, research question and hypothesis

Considering that the amount of Body Scan practice time people invest, could be correlated with the improvement of several symptoms (Means et al., 1999; Dreeben et al., 2013; Lengacher et al., 2009), then the further investigation of this is important in the context of insomnia. The MBSR technique is widely implemented in insomnia treatment and by conducting research of its importance within this treatment, the structure and support of the patients can be optimized and personalized. The present study focuses on the effectiveness of the MBSR-technique Body Scan as part of an online-based CBTI intervention, comparing participants, who performed self-help online relaxation exercises (above a cut-off score) with participants performing no self-help online relaxation (below a cut-off score). The aim is to investigate, if engagement in self-help online relaxation exercises has significant effects on the outcome variables, thus sleep-related measures (HSDQi and actigraphy).

The research question is:

Is the degree of engagement in mindfulness-based relaxation training in insomnia treatment for adolescents related to sleep outcomes?

Regarding the research question and the given information, the following hypothesis is formulated:

The degree of engagement in the Body Scan during treatment of insomnia is positively related to sleep outcomes.

It is expected that participants, who used Body Scan during the online-based CBTI, score lower on self-reported symptoms of insomnia (HSDQi), sleep onset latency (SOL) and wake after sleep onset (WASO), and higher on total sleep time (TST) and sleep efficiency. (SE).

Method

Design

This study was part of a larger randomized controlled trial (RCT) (De Bruin et al., 2015, 2018), registered at http://www.controlledtrials.com (ISRCTN33922163). The study was approved by the medical ethical committee of the Academic Medical Centre in Amsterdam and the design followed the CONSORT 2010 guidelines for RCTs (Moher et al., 2010). This study focuses on the condition Internet Treatment (IT), on which the participants were randomly assigned, using a simple randomization with an equal allocation ratio by referring to a table of random numbers (De Bruin, 2015, 2018). The measurements were online conducted at baseline (two weeks before the treatment), post-treatment and at 2-, 6- and 12-month follow-up from the start of the treatment (De Bruin et al., 2015, 2018). This study focuses on the effects between baseline and post-treatment and baseline and 2-month follow-up measures, in order to compare direct effects and effects on the long term.

Participants

The participants were recruited via advertisements, newsletters, lectures at schools and leaflets for healthcare professionals and signed up for the study via a web-form (De Bruin et al., 2015, 2018). On the webpage, the participants filled in questionnaires about demographic information, socioeconomic status, school level and the Hollands Sleep Disorders Questionnaire (HSDQ) for sleep problems. Furthermore, the parents of the participants filled in a questionnaire about demographic information. Purpose of the questionnaire was also to screen the participants for inclusion and exclusion criteria. If the inclusion criteria were met, a written informed consent was obtained from the participants and their parents and the participants were randomized to conditions, of which this study only uses the IT condition. Inclusion criteria were an age between 12 and 19 years, being in secondary school or after and meeting the diagnostic criteria of the DMS-IV for primary insomnia (De Bruin et al., 2015, 2018). Exclusion criteria were other sleep problems or confirmed psychiatric disorders, as well as physical problems that interfere with sleep, substance-related disorders and use of medication that can affect sleep (De Bruin et al., 2018). After the exclusion procedure and random assignment of the participants, the IT condition consisted of n=51 (mean age M= 15.4, SD= 1.7). The parents were generally informed about the study and the content of the treatment via a booklet they received, and that the treatment could be done independently by their child, although their support would be helpful for some exercises (De Bruin et al., 2015).

After calculating and comparing the frequency of engagement in Body Scan practice of the participants, the IT condition was separated in the conditions 'Body scan practice' (n=24) and 'No Body Scan practice' (n=27) (see Table 1). There were no significant differences in gender ($\chi^2(1, N=51) = .316$, $p > .05$) and age ($F(1, 49) = 1.278$, $p > .05$) between the two conditions.

Table 1

Demographic Characteristics of the Participants

Characteristic	**Category**	**Total** *(n=51)*		**Body scan practice** *(n=24)*		**No Body Scan practice** *(n=27)*	
		M	*SD*	*M*	*SD*	*M*	*SD*
Age	(years)	15.4	1.7	15.3	1.5	15.6	1.8
		n	*%*	*n*	*%*	*n*	*%*
Gender	Male	11	21.6	6	25	5	18.5
	Female	40	78.4	18	75	22	81.5

Materials/Measures

Directly before the start, after the end of the treatment and after 2 months of the end of the treatment, baseline, post-treatment and 2-months follow-up measurements were made via online questionnaires. Participants, whose response was delayed, received reminder messages (De Bruin et al., 2018).

Sleep was observed at all measurement times, with wrist actigraphy (Actiwatch® AW4; Cambridge Neurotechnology Ltd., Cambridge, UK) and sleep logs (Carney et al., 2012) for seven consecutive nights (De Bruin et al., 2018). The actigraphy measurements were done on the non-dominant wrist of the participants in 1-minute epochs and the data were registered with the medium-sensitivity algorithm, which has the highest sensitivity (0.96), specificity (0.42) and accuracy (0.79) for insomnia (Kushida et al., 2001; De Bruin et al., 2018). To indicate 'lights out' and 'get-up' times, participants used the event marker button of the actigraphy, which, together with sleep log variables, were used to calculate the outcome variables Time in Bed (TIB), Total Sleep Time (TST), Sleep Onset Latency (SOL), Wake After Sleep Onset (WASO) and Sleep Efficiency (SE) (De Bruin et al., 2015, 2018).

In order to measure insomnia symptoms, the subscale Insomnia of the Holland Sleep Disorders Questionnaire (HSDQi) (Kerkhof et al., 2012) was used. The HSDQ consists of 32 items that screen for common sleep disorders based on the six main categories from the International Classification of Sleep Disorders, Second Edition (American Academy of Sleep Medicine, 2005; Kerkhof et al., 2012). The subscale Insomnia (HSDQi) consists of eight items, rated on a five-point Likert scale from 1 (less symptoms of insomnia) to 5 (more symptoms of insomnia), e.g. 'Ik kan s'avonds moeilijk in slaap komen', which means 'I have difficulty falling asleep' or 'Ik heb overdag last van vermoeidheid', which means 'I feel sleepy during the day' (Kerkhof et al., 2012). In the present sample and in the sample of de Bruin et al. (2018), Cronbach's alpha ranged from .78 – .86 at the different measurement times.

Procedure

Participants received six weekly sessions of Cognitive Behavior Therapy for adolescent insomnia (CBTI), which was based on the CBTI protocol for adults but adapted for the use with adolescents by the research team and experienced CBTI sleep therapists (De Bruin et al., 2015). The treatment consisted of psychoeducation, sleep hygiene, restriction of time in bed, stimulus control, cognitive therapy and relaxation training in form of Body Scan practice. The online-based treatment was made available via a website where once a week, on fixed times, participants could log on to in order to receive exercises, movies, questionnaires, automated feedback, personalized bedtime advice and written feedback from a personal sleep therapist (De Bruin et al., 2015). Participants needed a time of about 90 minutes to complete each of the online sessions, where the session only was marked as 'completed' if all pages were accessed (De Bruin et al., 2018). Also, there was the possibility to repeat completed online sessions. After the second session, participants received a 15-minute online chat session with their personal therapist (De Bruin et al., 2015, 2018). In the second session, participants were introduced to the Body Scan exercise and could download an mp3, in order to practice the exercise every day. In their sleep logs, the participants had to record, how often they practiced the exercise per day and received automated feedback and written feedback from a sleep therapist at the end of the week (De Bruin et al., 2015, 2018). For more detailed information, see Table 2.

Table 2

Detailed Procedure of the Treatment

	Internet Therapy (IT)
Week 1	Overview of the six sessions. Psycho education and sleep hygiene. Overview sleep logs and sleep variables. Bedtimes advise (restriction of time in bed). Homework.
Week 2	Overview sleep logs and sleep variables. New bedtimes advise. Automated feedback on homework. Personal feedback from therapist. Exercise for worry. Relaxation exercise. Homework. During week 2: 15 minutes chat session with therapist.
Week 3	Overview sleep logs and sleep variables. New bedtimes advise. Automated feedback on homework. Personal feedback from therapist. Cognitive restructuring exercise – part one. Homework.
Week 4	Overview sleep logs and sleep variables. New bedtime advise. Automated feedback on homework. Personal feedback from therapist. Sleep restriction revisited. Cognitive restructuring exercise – part two. Homework.
Week 5	Overview sleep logs and sleep variables.

	New bedtimes advise. Automated feedback on homework. Personal feedback from therapist. Peer pressure exercise. Relapse prevention. Homework.
Week 6	Overview sleep logs and sleep variables. New bedtime advise. Automated feedback on homework. Personal feedback from therapist. Summary and relapse prevention. Evaluation. Preview of booster-session after 2 months.

Note. Reprinted with permission from de Bruin et al., 2015, p. 1917.

Data Analysis

Statistical analyses were done using IBM Statistical Package for Social Sciences (SPSS, version 23, SPSS Inc, Chicago, IL, USA). In order to compare effects of the Body Scan exercises, participants were divided into two conditions: 'Body Scan practice' and 'no Body Scan practice'. The participants were assigned in one of the conditions, depending on their score on a question with a 3-point ordinal scale that was included in the online sleep log the day before each session (in total four scores for sessions three to six). The question was 'On average, how often did you practice the Body Scan exercise in the past week?' and the scores ranged from 0 (not at all), 1 (once a few day), to 2 (every day). Participants were included into the 'Body Scan practice' condition, if they scored at least 2 or higher in total, which means at least everyday practice for one week, or several days for two or more weeks. Participants with a lower score were included in the 'no Body Scan practice' condition.

To compare demographic variables between the groups, one-way ANOVA and χ^2 test were used. In case of a significant difference between the groups, the particular variables were included in further analyses.

Within-group effect sizes were calculated for the sleep outcome variables (actigraphy and HSDQi), to indicate the degree of change in response to the treatment for each group using Cohen's *d* (d = [M2 − M1] / SDpooled, where M1 = baseline mean, M2 = post-test mean or follow-up mean, and SDpooled = pooled standard deviation). The interpretation of effect sizes was low effect $d = 0.2$, medium size effect $d = 0.5$ and large effect $d = 0.8$ (Cohen, 1988).

Five repeated measures ANOVA (rmANOVA) were conducted to test significant differences in outcomes between the groups, using practicing Body Scan or not practicing Body Scan as independent variables and sleep outcome variables (actigraphy and HSDQi) as dependent variables. All sleep outcome variables (HSDQi, SOL, WASO, TST and SE) were defined in three levels (baseline, post measurement and follow-up measurement). Missing data were imputed using a Maximum Likelihood estimation. All analyses were conducted using a 5% significance level.

Results

All scores are presented in Table 3. The table shows means and standard deviations (SD), as well as effect sizes (Cohen's *d*) of the different sleep outcome variables from baseline to post-test measure and from baseline to follow-up measure for both conditions.

Table 3

Means, standard deviations (SD) and within group effect sizes (Cohen's d) of sleep variables from actigraphy and HSDQi per condition at all measurement times

	Baseline	**Post-test**	**Baseline to Post-test**	**Follow-up**	**Baseline to Follow-up**
Variables per condition	**Mean (SD)**	**Mean (SD)**	**Cohen's *d***	**Mean (SD)**	**Cohen's *d***
Sleep onset latency, min					
Body Scan practice	38 (13)	23 (12)	1.19	17 (7)	2.01
No Body Scan practice	34 (14)	20 (11)	1.11	18 (9)	1.36
Wake after sleep onset, min					
Body scan practice	80 (26)	68 (22)	0.49	69 (17)	0.50
No Body Scan practice	75 (15)	74 (21)	0.05	76 (16)	-0.06
Total sleep time, min					
Body Scan practice	418 (34)	452 (63)	-0.67	410 (51)	0.18
No Body Scan practice	403 (31)	422 (45)	-0.49	416 (31)	-0.42
Sleep efficiency, %					
Body Scan practice	76.2 (4.9)	83.2 (3.9)	-1.58	82.3 (4.8)	-1.26
No Body Scan practice	76.7 (4.2)	81.7 (4.2)	-1.19	81.4 (3.5)	-1.21
HSDQi					
Body Scan practice	3.5 (0.6)	2.8 (0.8)	0.99	2.5 (0.7)	1.53
No Body Scan practice	3.6 (0.6)	3.1 (0.8)	0.71	2.8 (0.9)	1.05

Sleep onset latency (SOL)

The results of the repeated measures ANOVA showed that there was a significant main effect of the treatment on the SOL of the participants, F(2, 98) = 69.036, $p < .001$, which is also shown in large effect sizes in both of the conditions, as well from baseline to post-test measure as from baseline to follow-up measure (see Table 3). The results of the rmANOVA showed no significant main effect of the conditions, F(1, 49) = .509, $p = .479$, which means that there was no significant difference between the groups in their sleep onset latency throughout the three measurement moments. Furthermore, the interaction effect of treatment and condition was not significant, F(2, 98) = 1.283, $p = .282$, which means that there was no significant variation in the effect of the treatment between the two conditions (see Figure 1).

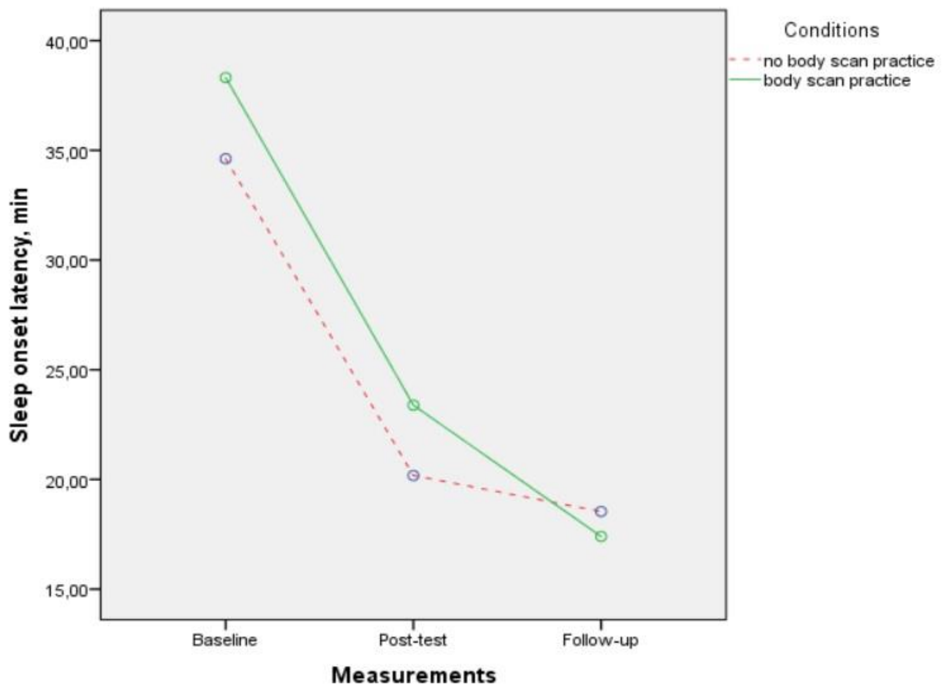

Figure 1 – Estimated means for sleep onset latency from actigraphy at baseline, post-test and follow-up measurements of the conditions 'Body Scan practice' and 'no Body Scan practice'

Wake after sleep onset (WASO)

There was a significant main effect of the treatment on the times of WASO of the participants, F(2, 98) = 3.612, $p = .031$, but the rmANOVA showed no significant main effect of the conditions, F(2, 98) = .288, $p = .594$, which means that there was no significant difference between the groups in their times wake after sleep onset throughout the three measurement moments. There was a significant interaction effect of the treatment and the condition, F(2, 98) = 4.071, p = .020, which means that there was a significant variation in the effect of the treatment between the two conditions (see Figure 2). This can also be seen in the different within-group effects sizes of the two conditions (see Table 3). The 'Body Scan practice' condition showed medium effect sizes from baseline to post-test (Cohen's d = 0.49) and baseline to follow-up measurement (Cohen's d = 0.50), while the 'no Body Scan' condition showed low effect sizes from baseline to post-test (Cohen's d = .05) and baseline to follow-up measurement (Cohen's d = –.06).

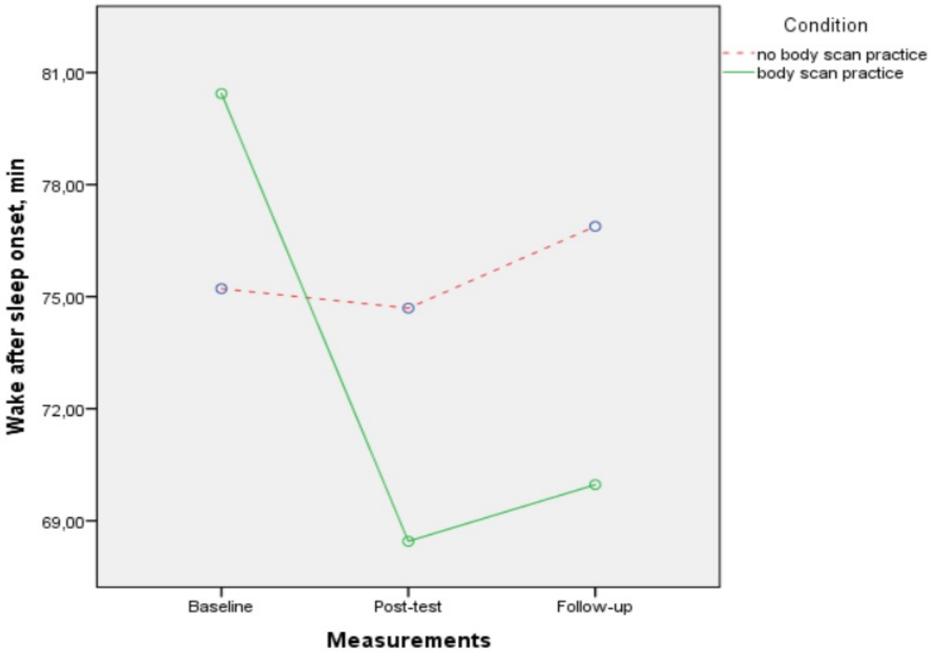

Figure 2 – Estimated means for wake after sleep onset from actigraphy at baseline, post-test and follow-up measurements of the conditions 'Body Scan practice' and 'no Body Scan practice'

Total sleep time (TST)

The results of the rmANOVA showed a significant main effect of the treatment on the total sleep time of the participants, F(1.639, 80.292) = 6.028, p = .006, whereby both conditions showed medium size within-group effect sizes from baseline to post-test measurement and low effects sizes from baseline to follow-up measurement (see Table 3). The rm ANOVA showed no significant main effect of the conditions, F(1, 49) = 2.814, p

= .100, which means that the difference between the groups in their total sleep time throughout the three measurement times was not significantly different and there was no significant interaction effects of the treatment and the conditions, F(1.639, 80.292) = 2.235, *p* = .123, which means that there was no significant variation in the effect of the treatment between the two conditions (see Figure 3). The Greenhouse-Geisser adjustment was used to correct for violations of sphericity.

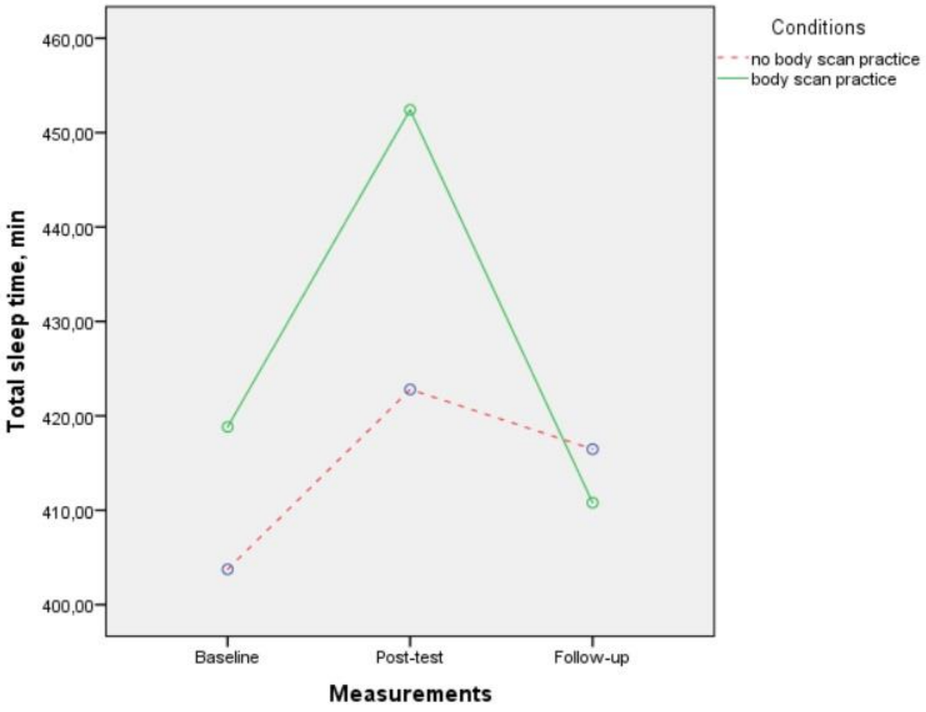

Figure 3 – Estimated means for total sleep time from actigraphy at baseline, post-test and follow-up measurements of the conditions 'Body Scan practice' and 'no Body Scan practice'

Sleep efficiency

The results of the rmANOVA showed a significant main effect of the treatment on the sleep efficiency of the participants, F(2, 98) = 78.178, *p* < .001, which can also be seen in large within-group effect sizes by both conditions (see Table 3). There was no significant main effect of the conditions, F(1, 48) = .367, p = .547, which means that there was no significant difference in the sleep efficiency between the two conditions throughout the three measurement moments. Furthermore, the results showed no significant interaction effect of the treatment and the conditions, F(2,98) = 1.983, *p* = .143, which means that there was no significant variation in the effect of the treatment between the two conditions (see Figure 4).

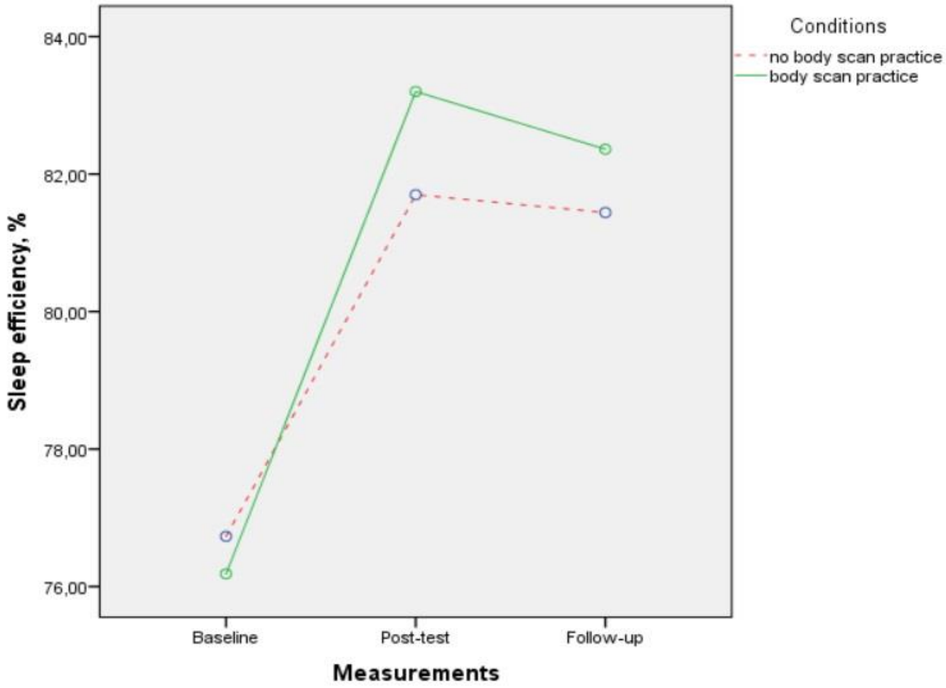

Figure 4 – Means for sleep efficiency from actigraphy at baseline, post-test and follow-up measurements of the conditions 'Body Scan practice' and 'no Body Scan practice'

Holland Sleep Disorder Questionnaire for Insomnia

The results of the rmANOVA showed a significant main effect of the treatment on the HSDQi scores of the participants, $F(1.666, 81.648) = 73.369$, $p < .001$, which can also be seen in large within-group effect sizes for both conditions from baseline to post-test measurement and baseline to follow-up measurement (see Table 3). There was no significant main effect of the conditions, $F(1, 49) = 2.057$, $p = .158$, which means that there was no significant difference between the two conditions in their HSDQi scores throughout the three measurement moments. Further, the rmANOVA showed no significant interaction effect of the treatment and the conditions, $F(1.666, 81.648) = 1.459$, $p = .238$, which means that there was no significant variation in the effect of the treatment between the two conditions (see Figure 5). The Greenhouse-Geisser adjustment was used to correct for violations of sphericity.

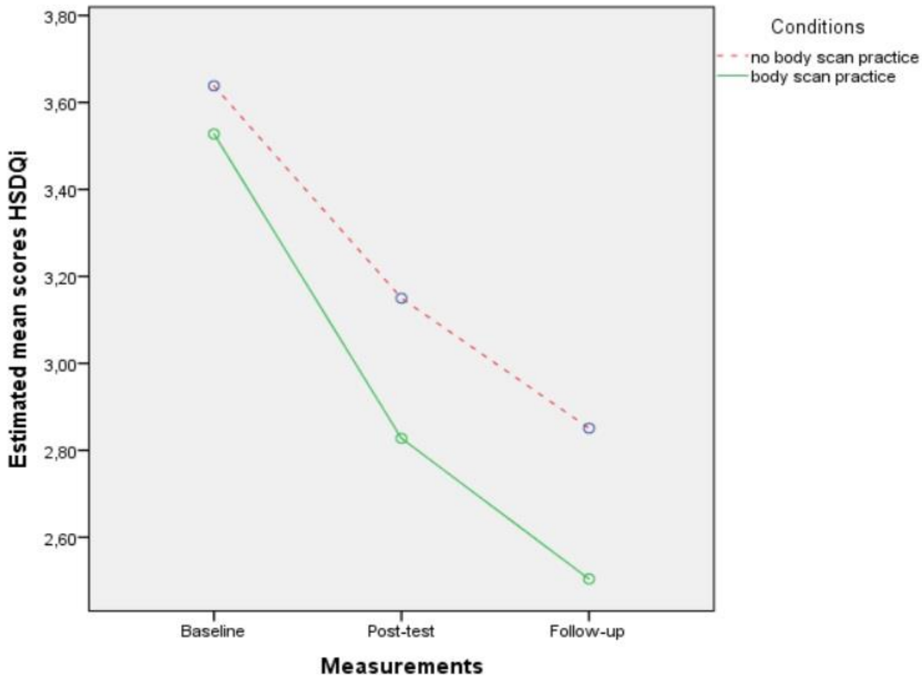

Figure 5 – Means of the Holland Sleep Disorder Questionnaire for Insomnia at baseline, post-test and follow-up measurements of the conditions 'Body Scan practice' and 'no Body Scan practice'

Discussion

In this research it was investigated, if engagement in Body Scan relaxation exercises during online-based treatment of insomnia for adolescents was positively related to sleep outcome variables of the participants. The results showed that there was a positive effect of the treatment on the sleep outcome variables of the participants with medium to large effect sizes from baseline to post-test and to follow up. Furthermore, for one actigraphy variable (WASO) a significant difference between the two conditions 'Body Scan practice' and 'no Body Scan practice' appeared, indicating that those participants who had engaged in the body scan during the six weeks of treatment, showed a greater decrease of WASO. The hypothesis that the degree of engagement in the Body Scan during treatment of insomnia is positively related to sleep outcomes was partly confirmed.

These findings are in line with findings from Bootzin and Stevens (2005), who conducted a multi-component intervention including mindfulness meditation for adolescents with insomnia complaints and substance abuse history. Participants who completed the intervention showed improvements in SOL, SE, TST and sleep quality. Wong, Lee and Ree (2015) also found similar results in their study about whether the effects of CBT for insomnia could be enhanced by adding either mindfulness-based therapy or Cognitive Therapy (CT). In their MBSR condition, they found significant improvements in TST, WASO and SE.

Effectiveness of the Body Scan as part of CBTI

The results of this study indicate that there was a more positive trend, if only small, of improvements in sleep outcome variables, if participants exercised Body Scan during their CBTI and it was shown, that Body Scan can have a positive effect on the sleep outcome variable WASO of the participants. It was expected that participants, who used Body Scan during the online-based CBTI, would show larger improvements on the HSDQi, SOL and WASO, than participants who did not use Body Scan during their treatment. Participants in the ‘Body Scan practice’ condition showed an overall greater improvement in the HSDQi, SOL and WASO, than participants in the ‘no Body Scan practice’ condition, indicating that using Body Scan exercises during CBTI may lead to a more positive trend of sleep outcome variables but only the effects on the variable WASO showed a significant difference between the two conditions. Participants who used Body Scan during their treatment showed a significantly greater decrease of minutes in their WASO score from baseline to post-test and baseline to follow-up, than participants who did not use Body Scan. Considering the baseline scores of both conditions, it is striking that the ‘Body Scan practice’ condition scores higher on WASO than the ‘no Body Scan practice’ condition. Nofzinger et al. (2006) concluded in their research that brain regions, that were activated during WASO phases in patients with insomnia, were consistent with patterns that represent emotional and physiological hyperarousal, which goes in line with the hyperarousal theory of insomnia (Perlis et al., 1997). This leads to the assumption, that participants who scored a greater level of WASO also subjectively experienced more insomnia symptoms and therefore a higher level of arousal, which in turn may lead to a greater urge to participate in the arousal-decreasing part of the treatment, the Body Scan. The significantly greater decrease of WASO time in the ‘Body Scan practice’ condition, compared to the ‘no Body Scan practice’ condition, may be referable to the fact that both conditions started with a different level of WASO and thus possibly also with a different severity of insomnia symptoms in general, so that the ‘no Body Scan practice’ condition did not have the same capacity of possible improvement, than the ‘Body Scan practice’ condition.

Furthermore, it was expected that participants in the 'Body Scan practice' condition would show a greater increase of total sleep time and sleep efficiency, than participants in the 'no Body Scan practice' condition. Although not statistically significantly, participants in the ‘Body Scan practice’ condition had a more positive trend of improvement than participants in the ‘no Body Scan practice’ condition throughout the CBTI treatment.

Strengths and limitations

This study has a lot of strengths, such as being part of a larger randomized controlled trial, using a two months follow-up measure, as well as subjective and objective measures, and its accessibility by being an online-based intervention. These strengths also bear some risks and limitations. The participants of the larger randomized controlled trial were recruited from the general population but participants with other sleep disorders, psychopathological disorder, substance- or medication-related disorders or physical problems that interfere with sleep were excluded. This may limit the generalizability to populations of adolescents in for example clinical settings and therefore lowers the external validity of the research. Furthermore, the assignment of the participants to one of the two conditions, used in this study, was not randomly done but via a self-report question within the treatment. There was no active control of how frequently the participants practiced the Body Scan and if this frequency fits the score on the self-report question. Additionally, there was no control about how constantly the participants in the 'Body Scan practice' condition actually practiced the Body Scan throughout the treatment and during the two months until the follow-up measure, which allows scope for other possible explanations of the results and lowers the internal validity of the study.

Suggestions for further research

Regarding that within this research, there was no objective control of how frequently the participants practiced the Body Scan, the scope for other possible explanations was enlarged and the internal validity lowered. A research with more control about the amount of Body Scan practice could give more insights in the effectiveness of this element of the CBTI. Through assigning participants to the conditions via a self-report question for further statistical research, the risk for different baseline levels of the five sleep outcome variables between the two conditions occurred. This too left scope for other explanations for the change in sleep outcome variables, than only the additional effectiveness of the Body Scan. Being able to objectively control the amount of Body Scan practice to a certain amount, by offering Body Scan lessons with a personal trainer or in group sessions during the treatment for instance, would give the possibility for a treatment group and an active control group, who takes part in a CBTI, but without the relaxation training part. Additionally, a random assignment would allow a similar mean level of severity of symptoms in the two groups and increase the possibility to conclude that the changes in sleep outcome variables can be explained by the differences in the treatment itself in the first place. Another possibility to get deeper insights, is to use questionnaires that measure the amount of mindfulness of the participants throughout the treatment, in order to detect changes in their ability to use the relaxation exercise and their subjective perception of its effectiveness. A possible questionnaire is the Five Facet Mindfulness Questionnaire (FFMQ), which measures five factors that appear to represent elements of mindfulness (Baer, Amith, Hopkins, Krietemeyer, & Toney, 2006).

Moreover, it would be interesting to conduct research about the effectiveness of the Body Scan as part of the CBTI in clinical populations of adolescents. There is evidence, that the reduction of CBTI also has an impact on the reduction of other comorbid disorders, due to their reciprocal causal relation (Roberts, Roberts, & Duong, 2008; Pasch, Laska, & Lytle, 2011; Roane & Taylor, 2008; Harmoen, Redlich, & Weerd, 2008) and that strengthens the importance to conduct further research on the effectiveness of its different parts to possibly optimize CBTI. The effectiveness of relaxation training may be an important indicator of the effectiveness of the CBTI treatment, regarding that the results of this study show several positive effects of the Body Scan on the sleep outcome variables of the participants.

Implications for the practice

The results of this study can have an added value for researchers and therapists, who are looking for a possibility to further study and optimize the effects of CBTI for adolescents, regarding the effects of the relaxation training as part of the whole treatment. This study shows that Body Scan practice during CBTI treatment has a positive effect on sleep outcome variables of the participants, and that it is an important part in reducing symptoms of insomnia in adolescents. The reduction of insomnia symptoms may also mean a reduction in symptoms of comorbid disorders, like depression and anxiety, if this treatment is applied in a clinical setting, for instance. For adolescents, who do not suffer from other psychopathological disorders yet, it could mean a preventive treatment to not slip further into the vicious cycle of being highly aroused, causing sleep problems, which in turn cause high levels of cognitive, emotional and physiological arousal, because of rumination and restlessness for example.

Conclusion

The results of this study show, that regularly practicing Body Scan positively affects the time participants are wake after sleep onset. This also refers to the assumption, that Body Scan positively affects states of hyperarousal in patients with insomnia, which in turn is a perpetuating factor of the disorder. The importance of Body Scan during insomnia treatment thus was supported by the findings of this study and that it can be a crucial part of online-based CBTI for adolescents. Because of this it is important to further investigate on which circumstances Body Scan can have an even more positive effect on symptom reduction of insomnia, so that patients suffering from this disorder can get treatment that is as effective as possible for them, in a best possible optimized and personalized way.

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