Master Thesis

To Sleep or Not to Sleep: Body Scan Effectiveness in Adolescents with Insomnia and Cooccurring Depression and Anxiety Symptoms within CBT-i Treatment

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Abstract

Objective Insomnia is one of the most prevalent disorders in adolescence, often cooccurring with depression and anxiety. CBT-i that includes the body scan has been shown effective in treating insomnia symptoms in adolescents. This study investigates the effectiveness of the body scan over time for adolescents with insomnia when of anxiety and depression symptoms are present at baseline.

Methods 54 adolescents who participated in a large RCT on a 6-week internet delivered CBT-i treatment that included the choice of using the body scan were divided into a body scan (BS) group (N = 26, age M = 15.33 years, SD = 1.42, 77% girls), and a no body scan (NBS) group (N = 28, age M = 15.64 years, SD = 1.80, 82% girls). Participants were assessed for anxiety and depression symptoms with the Youth Self-Report (YSR), for subjective insomnia symptoms with the Holland Sleep Disorder Questionnaire (HSDQ), and for objective sleep parameters using actigraphy. Group differences were analysed with multiple repeated measures ANOVA across three measurement points: baseline, post-treatment, and follow-up.

Results Trends were found in actigraphy insomnia measures of wake after sleep onset, and sleep efficiency between the BS and NBS group. No differential effects between groups in body scan effectiveness on sleep onset latency, wake after sleep onset, and sleep efficiency, measured with actigraphy were found, when including anxiety and depressive symptoms as moderator. A trend was found for the moderation of baseline anxiety symptoms and the self-report HSDQ insomnia sub-scale, though not for baseline depressive symptoms.

Conclusion Applying the body scan in a CBT-i intervention appears to be equally effective for adolescents with insomnia with or without cooccurring anxiety and depressive symptoms. Possible differences in patient characteristics including gender, motivation, and attitudes towards the body scan need to be further investigated.

Keywords: insomnia, adolescents, CBT-i, body scan, mindfulness, anxiety, depression

Contents

Introduction

Sleep is one of the most important resources for adolescents to restore mental and physical energy, while benefitting healthy brain maturation (Tarokh et al., 2016). Adolescence is marked by a period of change, stress, greater independence and autonomy, development, and social roles, all of which influence behaviour, including sleep. A meta-analysis on sleep parameters across the lifespan shows that while total sleep time and REM-sleep phases in children and teenagers decreases with age, their actual need for sleep does not (Ohayon, 2004). A disrupted sleep pattern in a phase where sleep is a crucial resource to draw from can create coping difficulties with other life stressors that characterize adolescence and thereby heighten the necessity for sleep to re-establish balance. Not restoring a healthy balance can potentially lead to a downward spiral of cause and effect, where sleep problems and other stressors accelerate one another. Not surprisingly, sleep disorders frequently occur during adolescence with insomnia being among the most common ones showing a prevalence of 9 - 23.8% in adolescence (Hysing et al., 2013). Insomnia is characterized by poor sleep quality or quantity, difficulty falling asleep, maintaining sleep or waking without being able to re-initiate sleep (Buysse, 2013).

It has been shown that insomnia is associated with pre-sleep hyperarousal characterized by (meta) cognition and somatic body tension, both of which were found to have a bidirectional relationship (Palagini et al., 2017). Adolescent's difficulties to initiate and maintain sleep are affected by an overactive body and mind, with either one potentially influencing the other. Insomnia commonly cooccurs with anxiety and depression; pathologies that share overlapping symptom profiles with insomnia (e.g., Chase & Pincus, 2011; Kelly & El-Sheikh, 2014). Purely cognitive methods for insomnia were found to be less effective than body integrative methods, such as mindfulness relaxation with the body scan (De Bruin et al., 2020; Dewald-Kaufmann et al. 2019). Investigating the role of these body-integrative techniques for insomnia treatment in cooccurrence with anxiety and depression can inform and tailor treatment approaches as well as increase their accessibility.

Insomnia

Psychophysiological Mechanisms of Insomnia

Healthy sleep requires a certain level of relaxation and calmness of both body and mind. To be diagnosed with insomnia disorder, sleep difficulties including falling asleep and maintaining sleep must be recurrent for at least three months and happen on at least three nights in a week, with additional impairment of functioning or significant distress in school, or other important areas in life (American Psychiatric Association, 2013). Insomnia is related to a state of hyperarousal in cognitive and physiological states, as well as the central- and autonomic nervous system, which reduces the ability to disengaging with, and not respond to the environment (Riemann et al., 2010; Carskadon & Dement, 2011). From a cognitive perspective, individuals with insomnia experience worry and cognitive intrusions, most commonly related to needing sufficient sleep and consequences of not sleeping enough (Harvey, 2002). A model by Dahl (1996) of the psychobiology of sleep regulation proposes vigilance and sleep as two opposites of the same continuum being regulated by the prefrontal cortex (PFC). The PFC's function is to regulate emotions, behaviour, and direct attention; an imbalanced PFC due to sleep deprivation disrupts these areas. Taken together, these symptoms interfere with the relaxation and calmness necessary for initiating and maintaining sleep; body and mind tend to be overactive.

Insomnia in Relation to Anxiety and Depression

It is not uncommon for insomnia to appear with other mental disorders, most frequently anxiety and depression. The nature of this relationship has been thoroughly investigated in a number of studies, pointing towards a bilateral association. On the one hand, it has been shown that sleep impairment is a significant predictor for anxiety and depressive symptoms (Kelly & El-Sheikh, 2014). The cognitive hyperarousal in the form of worry may evolve into anxiety related to sleep, which in turn leads to sleep-counteracting behaviour due to anxiety induced vigilance, for example by checking the time repeatedly during the night (Harvey, 2002). In a meta-analysis by Lovato and Gradisar (2014), insomnia was identified as a frequent precursor to the development of depression, likely due to the reinforced rumination while lying awake in bed, further leading to irritability, lack of energy, and concentration difficulties. The symptom patterns of insomnia can potentially lead to the unfolding of anxiety and depression when symptoms are exacerbated.

On the other hand, symptoms of depression and anxiety interrupt a healthy sleep, potentially contributing to insomnia development. Symptom characteristics are emotional distress, worry, rumination, as well as high alertness and hyper-vigilance (Dahl, 1996). Apart from PFC processes, anxiety and depression have been associated with higher nervous system arousal and cortisol (stress hormone) levels before sleep, especially in adolescents, thus influencing sleep quality and quantity (Dahl, 1996; El-Sheikh et al., 2008; Forbes et al., 2007). Studies with adolescents show that anxiety disorders are a frequent predictor of insomnia, and that insomnia is most likely developed after the onset of an anxiety disorder (Chase & Pincus, 2011; Johnson et al., 2006). Due to the high prevalence of insomnia in adolescence and its comorbidity with depression and anxiety, this sleep disorder raises a considerable public mental health concern. It is yet to determine whether and how insomnia treatment approaches are affected by the cooccurrence of anxiety and depression at the beginning of treatment. By investigating the relation of insomnia, depression, and anxiety further, treatment can become more informed, tailored, as well as made more accessible.

CBT for Insomnia (CBT-i)

The initial treatment approach for insomnia is Cognitive Behaviour Therapy for insomnia (CBT-i) (Mitchell et al., 2014). CBT-i aims to change dysfunctional behavioural and cognitive patterns especially occurring before bedtime; pre-bedtime stimulus control, sleep hygiene, relaxation training, as well as psychoeducation, cognitive therapy and sleep restriction are included in treatment. Research has proven CBT-i to be effective when treating adolescents with insomnia (e.g., De Bruin et al., 2015; Dewald-Kaufmann et al., 2019). Highest treatment effects have been attributed to the intensity and consistency of intervention components that have been applied - for example strictly adhering to sleep hygiene recommendations as opposed to loosely following them on only some days (Groot & De Bruin, 2020). CBT-i has also shown effective when applied to adolescents with cooccurring mental health problems, such as affective or anxiety disorders, where a decrease in insomnia symptom led to a decrease of psychopathology (De Bruin et al, 2017; Dewald-Kaufmann et al., 2019).

Potential of the Body Scan

Recently, CBT-i has been complemented by mindfulness-based methods (e.g., Wong et al., 2017). Mindfulness is characterized by a moment-to-moment awareness of the present, with a non-judgemental and accepting attitude, which makes use of noticing physical body sensations (Kabat-Zinn, 2016). Often used mindfulness-based CBT-i methods are relaxation techniques such as the body scan (National Institute for Complementary and Integrative Health, 2018). The body scan is a technique in which one lies down and progressively moves attention through the body by systematically breathing and relaxing into each body region while adopting a mindful moment-to-moment awareness (Kabat-Zinn, 2016). Its beneficial nature lies in the calming of motor neurons that guide muscular tension, which translates to the relaxation of the mind.

A recent secondary study built upon a larger randomised control trial study by De Bruin and colleagues (2017) that researched CBT-i effectiveness and pathology symptom reduction found a considerable decrease in wake after sleep onset when using the body scan, indicated by less movement while sleeping (De Bruin et al., 2020). In this study, body scans were suggested to decrease sleep difficulties by decreasing cognitive and physiological arousal before bed, while purely cognitive techniques were not found to have this effect (De Bruin et al., 2020; Dewald-Kaufmann et al. 2019). More specifically, body scan effectiveness might be explained by the ability to take attention away from the mind's contents, such as worries, and directing it towards the body and the breath. Mindful relaxation through the body scan seems to benefit insomnia symptoms, by decreasing arousal and hypertension of mind and body.

As stated above, insomnia, depression, and anxiety symptoms overlap in some aspects, including cognitive and physical arousal before sleep; areas the body scan has shown to benefit. However, symptoms of depression and anxiety are not only congregated around sleep but manifest throughout the day and other areas, as well as differ from insomnia in their symptom profiles in some aspects (American Psychological Association, 2013). For example, depressive profiles are often characterized by a negative mood and lack of motivation while anxiety symptoms often encompass general worry or low self-esteem.

Studies researching the effectiveness of mindfulness based cognitive therapy that included a body scan mediation in adolescents with depression or sub-threshold depressive symptoms found treatment to be effective in reducing depressive symptoms as well as rumination levels (Raj et al., 2019; Zhang et al., 2019). A group therapy study on mindfulness techniques in adolescents that included the body-scan found considerable improvements specifically in anxiety levels, internalizing symptoms, as well as attention (Crowley et al., 2017). In addition, a study researching sleep interventions in adolescents that included mindfulness components, however not the body scan per se, found highest treatment effects for those with greater anxiety and depression symptoms prior to treatment (Blake et al., 2018).

Literature supports body scan effectiveness in adolescents for insomnia, depression, and anxiety symptom reduction respectively. However, studies focusing on body scan effectiveness on these three interconnected and mutually influential pathologies simultaneously is lacking. Individual symptom characteristics of each disorder, despite some symptom-overlap, suggest that adolescents experiencing cooccurrences of insomnia with anxiety and depression display a wider array of symptoms. With the body scan benefitting symptom alleviation of all three disorders, a larger baseline level of symptoms due to a cooccurrence of anxiety or depression with insomnia prior to therapy is thought to result in a greater cascade of symptom reduction than individuals only displaying insomnia symptoms. The bidirectional associations of these disorders highlight mutual causation and symptom acceleration. It is suggested that this reciprocity might also translate into mutual symptom reduction, resulting in a positive spiral.

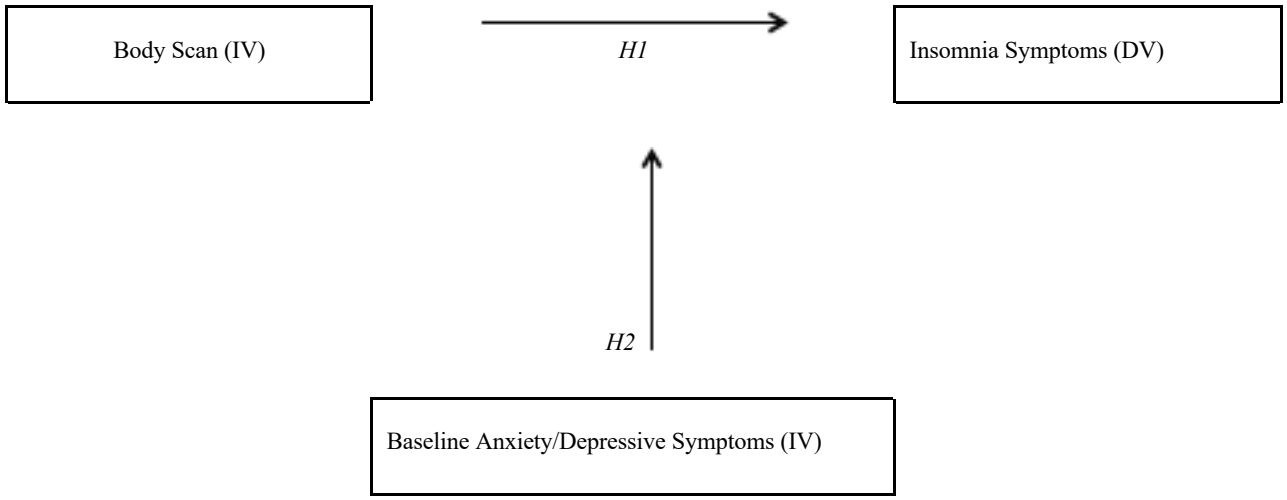
Present Study

The present study is a secondary study based on a randomized control trial by De Bruin and colleagues (2017) and adds to a recent study that identified beneficial aspects of the body scan on insomnia symptoms (De Bruin et al., 2020). This study aims to investigate a possible differential effect of body scan effectiveness in adolescents with insomnia symptoms when baseline anxiety- and depression-symptoms are cooccurring. It is hypothesized that application of the body scan relieves symptoms of insomnia in adolescents (H1), to confirm De Bruin and colleagues (2020). The effect of the body scan on insomnia is hypothesized to be moderated by the baseline level of depression and anxiety (H2). Figure 1

visualizes the proposed model. Given the public mental health concern insomnia creates in adolescent populations, as well as the many facets of insomnia and cooccurrences of other disorders that accelerate symptoms, treatment should be tailored to individual needs accordingly. Investigating these concepts more extensively can highlight potential benefits of shifting CBT-i focus towards a more mindfulness and body-relaxation integrated intervention for patients with certain symptom profiles or point towards a more equal applicability of using the body scan in CBT-i, thereby directing future research efforts.

Figure 1

Model of Moderation and Hypotheses



Methods

Study Design

This is a secondary study based on the research by De Bruin and colleagues (2017; 2020), with a mixed effects longitudinal repeated measures design. Two groups were compared: a body scan group (BS) and a no body scan group (NBS) within a CBT-i intervention. Daily measures were obtained at three measurement occasions; at baseline prior to the intervention (T0), directly after the intervention (T1), and at follow up (T2).

Participants

This study merged data from two sub-samples of the same participants (De Bruin et al., 2020) and

included a total sample of 54 adolescents with mean age of 15.5 (SD = 1.62) of which 80 % were female, and 20% male. Participants received internet-delivered CBT-i treatment in an overarching study that investigated CBT-i effectiveness for adolescents (De Bruin et al., 2015). Participants were recruited via advertisements, online newsletters and media, mental health care professionals, and schools. Inclusion criteria were (1) age between 12 and 19 years and (2) presence of insomnia disorder diagnosis screened as part of the main study (De Bruin et al. 2017) with the Holland Sleep Disorder Questionnaire (HSDQ; Kerkhof et al. 2013) either alone-standing or in cooccurrence with depression or anxiety screened with the Youth Self-Report (YSR; Achenbach, 1991) according to DSM-V criteria (American Psychiatric Association, 2013). Exclusion criteria were (1) suicidality and drug abuse screened for by the YSR (Achenbach 1991) and an intake interview; (2) the presence of other sleep disorders apart from insomnia; (3) use of sleep medication or sleep-altering drugs; (4) other current treatment for sleep problems or comorbid depression/anxiety; (5) diagnosis of comorbid mental disorders other than anxiety and depression.

Procedure

This study was part of a larger study investigating the effectiveness of CBT-i for adolescents, approved by the medical ethical committee of the Academic Medical Centre in Amsterdam, and registered at the International Standard Randomized Controlled Trial Number Register (ISRCTN33922163). Participants of that study were screened for in- and exclusion criteria and written informed consent was obtained by those fitting into the criteria. The Youth Self Report (Achenbach, 1991) was filled in online, and participants were assessed for insomnia diagnosis (DSM-V, American Psychology Association, 2013) in a 60-minute face-to-face interview with a psychologist specialised in sleep medicine. All participants were assigned randomly to internet-delivered CBT-i. The CBT-i intervention consisted of a total of six sessions that were given weekly over a period of six weeks and included psychoeducation, sleep hygiene, bedtime restriction, stimulus control, cognitive therapy, and body scan meditation. Groups were inductively generated after the CBT-i intervention; participants were grouped based on voluntary participation in the body scan meditation or no participation in the body scan

meditation.

Materials

Intervention. The CBT-i intervention was delivered online by certified sleep psychotherapists, for which participants logged into a website at the given time. Sessions were transmitted via video and sound files, including written exercises, interactive questionnaires, automated feedback, as well as written personalized feedback from a sleep therapist. After session two, there was an individual 15-minute conversation with the participant's assigned therapist. During the entire intervention, participants could visit the website to post questions that were answered by their assigned sleep therapist in the weekly personalized feedback or via the chat sessions.

Each session began with a revision of sleep variables documented in the sleep logs. Based on these data, sleep advice was given and CBT-i exercises were either newly introduced or instructed to be continued. The body scan meditation was delivered via a 20-minute audio recording by a licensed Mindfulness-CBT professional and was introduced to participants in the second session. The audio recording could either be used online or downloaded for offline use. In each of the following weekly sessions (week 3-6) the body scan was reviewed and explained in more detail in terms of possible effects on stress, arousal, relaxation and their possible effect on sleep. The body scan and other CBT-i exercises were performed by an actress/actor and recorded on video for demonstration. The automated and personalized feedback encouraged the body scan meditation along other CBT-i techniques, but participants could choose freely whether or not to engage in them.

Measures

Measurements were collected at baseline, immediately after treatment, and at two months follow-up. Sleep logs and actigraphy were used to gather information on sleep parameters for seven consecutive days at each measurement point. Questionnaires measuring insomnia symptoms as well as depressive and anxiety symptoms were administered during these measurement points as well.

Use of Body Scan. A question asking for the use of the body scan meditation was integrated in the online sleep log and was assessed the day prior to each session; "On average, how often did you

practice the body scan exercise in the past week?". The question was assessed for times in total and was answered with a 3-point Likert scale from 0 (not at all), 1 (once or a few days), and 2 (every day). Four scores (from week 3 to 6) for each participant were obtained, ranging from 0-8. A body scan mean score per participant was created by dividing each score by four, representing the times of assessment and leaving a possible mean score ranging from 0 to 2. Participants were considered to have engaged in the body scan exercise if they scored above 1 on average. Two groups were created according to participants' engagement with the body scan meditation: a no body scan group (BS) and a body scan group (NBS).

Insomnia. Insomnia Symptoms were measured with the insomnia sub scale of the Holland Sleep Disorder Questionnaire (Kerkhof et al. 2012). The sub scale consists of eight self-description items rated on a 5-point Likert scale (e.g., "I feel sleepy during the day"), ranging from 1 = not at all to 5= completely. Higher scores indicate more severe insomnia symptoms, lower scores indicate milder insomnia symptoms, with a cut-off score of 3.68. Cronbach's alpha was 0.88 in a sample that included adolescents from the general population, as well as clinical population (Van Maanen et al., 2014).

Baseline Depression and Anxiety Symptoms. Depressive and anxiety symptoms were assessed by two sub scales of the Youth Self Report which are based on the DSM-IV: *Affective problems*, and *Anxiety problems* (Achenbach, 1991). The YSR is a self-report questionnaire assessing psychopathology in adolescents. It is comprised of 119 total items assessed with a 3-point Likert scale ranging from 0 to 2, with 0 = not true, to 2 = very true or often true. Higher scores indicate greater pathology symptoms on both scales respectively. Cronbach's alpha of the YSR ranged from 0.90 to 0.92 in a Dutch normative sample, from .68 to .79 for the *Affective Problems* sub-scale, and from *.61 to .70* for the *Anxiety Problems* sub-scale (De Bruin et al., 2017; Ebesutani et al., 2011).

Objective Sleep Parameters. Objective sleep was measured through wrist actigraphy, which measures sleep parameters through assessing movement during sleep, collected by a device similar to a wristwatch, worn while sleeping (Actiwatch ®AW4; Cambridge Neurotechnology Ltd., Cambridge, UK**)**. Individuals pressed a respective button on the actigraphy representative for either "lights out" or "get-up" times. Data was registered in 1-minute intervals. Sleep efficiency (SE) was assessed, as well as wake after

sleep onset (WASO), and sleep onset latency (SOL).

Data Analysis

Scale reliability was tested with Cronbach's alpha statistic for the insomnia sub-scale of the HSDQ, at baseline, post-treatment, and follow-up, and for the DSM-IV based sub-scales affective problems and anxiety problems of the YSR at baseline. Normality was tested with Shapiro-Wilk statistic and Levene's power estimation test for the outcome measures; the HSDQ insomnia sub-scale, the anxiety and affective sub-scales of the YSR, and the sleep efficiency from actigraphy. Normality can be assumed when kurtosis and skewness was between -2 and +2, as indicated by Fields (2013). To test the effect of the body scan on the reduction of insomnia symptoms in adolescents (H1), and the moderation of baseline depression and anxiety symptoms on that effect (H2), repeated measures ANOVA were used with the three measurement points as levels of measurement. Included as outcome measures were the HSDQ insomnia sub-scale, actigraphy of sleep efficiency (SE), of sleep onset latency (SOL), and of awake after sleep onset (WASO). Baseline levels of depression and anxiety measured by the affective- and anxiety problems sub-scales of the YSR were added as covariates to test for moderation. Each measurement outcome (WASO, SE, SOL, HSDQ) was analysed separately from the other outcome measures and analysed separately for each covariate.

Results

The sample was inductively divided into two groups, based on the scores of the consistency the body-scan was applied: a body scan group (BS) of 26 participants (M_{age}= 15.33, SD= 1.42, 77% female), and a no body scan group (NBS) of 28 participants (M_{age}= 15.64, SD = 1.80, 82% female). No significant differences occurred between the BS and the NBS group in age ($t(52) = 0.71$, $p > 0.05$) or gender ($\chi2(1) = 0.23$, $p > 0.05$). Assumption testing revealed good reliability for all measurements, except for the YSR sub-scale for baseline anxiety problems which displayed moderate reliability ($\alpha = .60$). All outcome variables appeared normally distributed, except for sleep efficiency actigraphy at post-treatment which showed high kurtosis of 4.43 (SE= .64) also after controlling for outliers.

Table 1 shows the outcome means and standard deviations for both groups at pre-treatment, post-treatment, and follow-up. It seems that participants of the BS group started out at a lower sleep efficiency and higher WASO at pre-treatment but ended up higher in sleep efficiency and lower WASO after treatment and follow-up than the no body scan (NBS) group (Figure 1 & Figure 2). Both groups started out at about the same level of insomnia symptoms, but the body scan (BS) group appears to show less symptoms than the no body-scan group at post-treatment and follow-up.

Table 1

Means, standard deviations, and within-group effect sizes (Cohen's d) of sleep variables from actigraphy, sleep logs, and questionnaires.

Sleep parameter	Baseline M (SD)	Post-treatment M (SD)	Cohen's d	Follow-up M (SD)	Cohen's d
Actigraphy					
BS Group					
SOL	38.47 (24.76)	21.27 (19.20)	- 0.72	15.11 (12.93)	- 1.10
WASO	81.55 (37.23)	71.29 (28.02)	- 0.29	65.92 (23.35)	- 0.47
SE	76.09 (7.68)	82.86 (5.58)	0.94	84.24 (5.29)	1.15
NBS Group					
SOL	33.80 (24.05)	20.49 (17.78)	- 0.59	18.33 (15.87)	- 0.71
WASO	73.32 (23.67)	72.60 (27.68)	- 0.03	74.13 (24.40)	0.03
SE	77.41 (6.63)	81.50 (5.00)	0.65	81.69 (4.73)	0.70
HDSQ insomnia sub-scale					
BS Group	3.49 (0.53)	2.85 (0.76)	- 0.91	2.53 (0.66)	-1.49
NBS Group	3.55 (0.59)	3.06 (0.72)	- 0.70	2.80 (0.86)	-0.96

Note: Complete overview of all sleep parameters can be found in De Bruin and colleagues (2020).

Figure 2

Plots for insomnia symptom measurements for HSDQ insomnia sub-scale, sleep efficiency (SE), sleep onset latency (SOL), and wake after sleep onset (WASO) with affective problems as covariate.

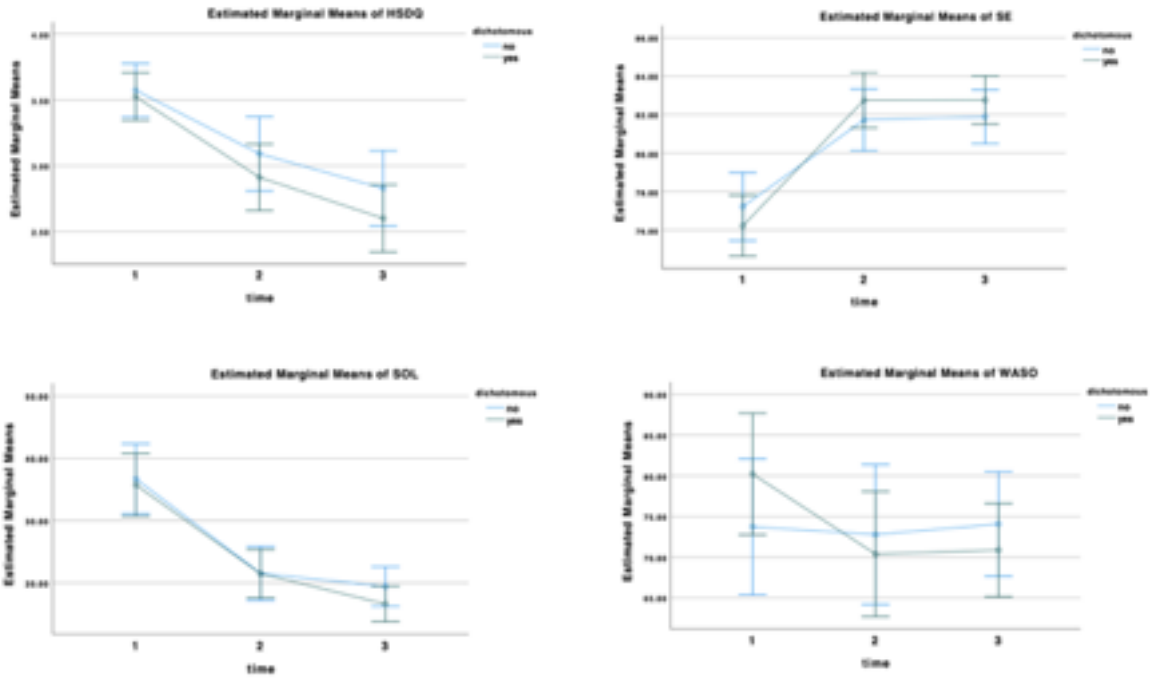
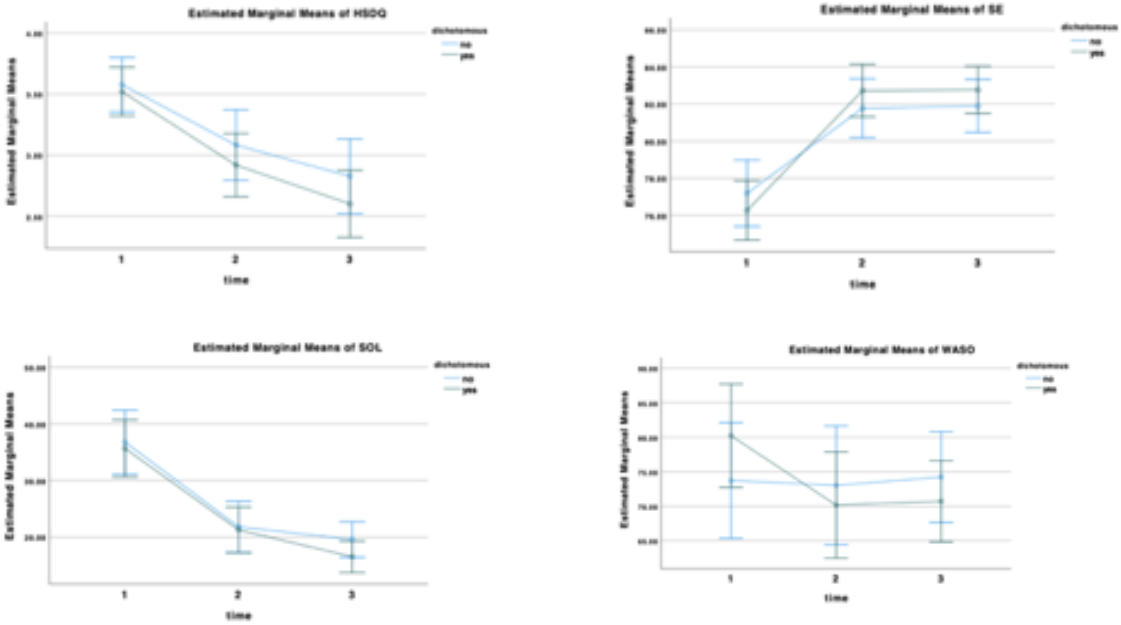


Figure 3

Plots for insomnia symptom measurements for HSDQ insomnia sub-scale, sleep efficiency (SE), sleep onset latency (SOL), and wake after sleep onset (WASO) with anxiety problems as covariate.



Sphericity testing with Mauchly's test revealed equal variance in differences between the BS and NBS group in all measures, except for the HDSQ insomnia sub-scale where assumption of sphericity was not met with $\chi 2$ (2) = 10.26, p = .006, which was corrected for using Greenhouse-Geisser statistic (Fields, 2013). Results of the repeated measures ANOVA are displayed in Table 2. To test whether the body scan has an effect on insomnia symptoms over time (H1), a repeated measures ANOVA for each measurement outcome and the effect across the three measurements was applied. Results show a significant effect of the body scan in the body scan (BS) group over time as compared to the no body scan (NBS) group on insomnia symptom reduction with both affective problems and anxiety problems as covariate respectively when measured by the HDSQ with $F_{affectiveproblems}(2, 53) = 10.82$, $p < .000$ and $F_{anxietyproblems}(2, 53) = 8.57$, $p = .001$, sleep efficiency actigraphy (SE) with $F_{affectiveproblems}(2, 53) = 7.69$, $p = .001$, and $F_{anxietyproblems}(2, 53) = 8.91$, $p < .000$, and sleep onset latency actigraphy (SOL) with $F_{affectiveproblems}(2, 53) = 4.26$, $p = .017$, and $F_{anxietyproblems}(2,53) = 11.05$, $p < .000$. The time effect is also significant for wake after sleep onset (WASO) in the analysis with affective problems as covariate ($F_{affectiveproblems}(2, 53) = 3.24$, $p = .043$), and a trend was visible when anxiety problems were added as covariate ($F_{anxietyproblems}(2, 53) = 2.51$, $p = .087$).

A trend is visible in the effect of the body scan between the BS and NBS groups on improved SE when affective problems were included as covariate (F (2, 53) =2.81, p = .065), and when anxiety problems were included as covariate (F (2, 53) =2.56, p = .082). In WASO there is also a trend visible when affective problems or anxiety problems were included as covariate respectively, while the latter approached significance more closely ($F_{affectiveproblems}(2, 53) = 2.86$, $p = .062$; $F_{anxietyproblems}(2, 53) = 3.04$, $p = .52$).

To test for moderation of baseline anxiety and depressive symptoms on the effect of the body scan to reduce insomnia symptoms (H2), repeated measures ANOVA for each measurement outcome and the effect across three measurement points included affective problems and anxiety problems as covariates. There is no significant effect in insomnia symptom improvement between both groups in relation to the HSDQ insomnia-sub-scale when including affective problems or anxiety problems as covariate ($F_{affectiveproblems}$ (2, 53) = .89, p = .396; ($F_{anxietyproblems}$ (2, 53) = 0.76, p = .436). No significant effect was found for SOL when including affective or anxiety problems as covariate ($F_{affectiveproblems}$ (2, 53) = .36, p =

.699; $F_{anxietyproblems}$ (2, 53) = .407, p = .667). No significant effect was found for the baseline level of affective problems (HSDQ: F (2, 53) = .58, p = .535; SE: F (2, 53) =.779, p = .462; SOL: F (2, 53) = .84, p = .433; WASO: F (2, 53) = 1.68, p = .191) or anxiety problems (SE: F (2, 53) =.1.87, p = .160; SOL: F (2, 53) = 1.22, p = .301; WASO: F (2, 53) = .87, p = .421) between groups on insomnia symptom improvement. A trend was found between groups for the HSDQ insomnia sub-scale and baseline anxiety problems (F(2, 53) = 2.79, p = .075). The improvement in insomnia symptoms over time was not moderated by baseline affective or anxiety problems in most outcome measures.

Table 2

F and p values of repeated measures ANOVA across three measurement points with affective problems and anxiety problems as covariate.

	HSDQ		SE		SOL		WASO	
	F	*p*	F	*p*	F	*p*	F	*p*
Affective Problems								
Time	10.82	**.000***	7.69	**.001***	4.26	**.017***	3.24	**.043***
Time x Body Scan	.89	.396	2.81	.065	.36	.699	2.86	.062
Time x Affective	.58	.535	.78	.462	.84	.433	1.68	.191
Anxiety Problems								
Time	8.57	**.001***	8.91	**.000***	11.05	**.000***	2.51	.087
Time x Body Scan	.76	.436	2.56	.082	.407	.667	3.04	.052
Time x Anxiety	2.79	.075	1.87	.160	1.22	.301	.87	.421

*p level significant (p< 0.05)

Discussion

The present study investigated whether baseline levels of depressive and anxiety symptoms create a differential effect of body scan effectiveness on insomnia symptom improvement in adolescents within

CBT-i treatment. Taking individual symptoms facets and characteristics into account directs efforts to inform and tailor insomnia interventions, thereby addressing the public mental health concern of insomnia in adolescent populations. This study builds on a primary study by De Bruin and colleagues (2017) and an associated study on the body scan in CBT-i treatment in adolescents (De Bruin et al., 2020). Based on self-reported use of the body scan meditation, 54 participants were divided into two groups: a body scan group and a no body scan group. Baseline depression and anxiety symptoms were assessed before treatment. Both groups received CBT-i via the internet and were compared on basis of self-reported insomnia symptoms and objective sleep outcomes (sleep onset latency, wake after sleep onset, sleep efficiency) measured by actigraphy at pre-treatment, post-treatment, and follow-up.

To confirm the study by De Bruin and colleagues (2020), it was hypothesized that there is a differential effect of body scan effectiveness in a CBT-i intervention for adolescents with insomnia who did or did not use the body scan. Results show improvements in both groups over time across both objective and self-reported measurements. In comparison to the no body scan (NBS) group, the body scan (BS) group showed greater improvements specifically in wake after sleep onset (WASO) and sleep efficiency (SE). Body scan effectiveness was lower in both groups for WASO improvements when baseline anxiety was included in the model. Results confirm the first hypothesis and are in line with De Bruin and colleagues (2020), who found differential effects in the BS group in WASO improvements compared to the NBS group. This study found additional effects of body scan use for SE improvements.

Secondly, it was hypothesized that the overall effect of using the body scan on insomnia symptom reduction is moderated by baseline anxiety and depressive symptoms. Findings show conflicting results, which both reject and support the hypothesis depending on which and how the insomnia symptoms are measured. Results indicate that body scan effectiveness on sleep onset latency (SOL), wake after sleep onset (WASO), and sleep efficiency (SE) improvement was not influenced by baseline anxiety and depressive symptoms. Secondly, only baseline anxiety symptoms were found to interact with body scan effectiveness on self-reported insomnia symptom reduction. Prior to treatment, both groups start off with similar insomnia symptom levels, while for those with anxiety symptoms a greater decrease of self-

reported insomnia symptoms was visible after using the body scan. The interaction of baseline anxiety symptoms with the insomnia symptom self-report aligns with previous literature that found greater treatment effects of a mindfulness-based sleep intervention for adolescents with high baseline and anxiety symptoms (Blake et al., 2018). Baseline anxiety and depression symptoms did not interact with objective measures (SOL, WASO, SE) as measured by actigraphy, not in line with previous findings.

Implications

Studies have shown greater motor activity and movement during sleep in adolescents with insomnia, as well as reported greater cognitive arousal before sleep, both of which interfere with healthy sleep (Carskadon & Dement, 2011; De Bruin et al., 2020). Body scan effectiveness on improving sleep efficiency and wake after sleep onset shown in this study might thus be explained by the body scan's ability to reduce exactly this cognitive and physical arousal (Carskadon & Dement, 2011; De Bruin et al., 2020). The additional finding of the present study that the body scan use not only improves wake after sleep onset (WASO), but also sleep efficiency (SE) can be explained by the use of separate analysis for both WASO and SE, which are interrelated concepts, as a healthy WASO determines improved SE. Findings imply that the body scan especially reduces insomnia symptoms that happen during the sleep period. The body scan continues to be an effective and important tool in adolescent CBT-i treatment as it accounts for symptom improvements of sleep related insomnia factors.SEPBody scan effectiveness on self-reported insomnia symptoms was moderated by anxiety symptoms, not depressive symptoms at baseline, even though both symptom profiles overlap to a considerable extent. Nonetheless their symptomatic similarities there are some differences that might explain these findings. Depression, for instance, is characterised by a generally lower motivation, as well as a negativity bias which is to pay attention and give weight to negative contents of the mind (American Psychiatric Association, 2013). Differential characteristics of anxiety on the other hand are excessive worry and fear extending towards multiple areas of life, for example social or academic performance (American Psychiatric Association, 2013). The body scan meditation helps individuals to let go of mental activity and drop into the experiences of the body. It is furthermore based on mindfulness, non-judgement, and acceptance, all of which might be foreign

concepts that require some degree of openness to the experience or might be prone to prejudices (Kabat-Zinn, 2016). Participants with cooccurring depressive symptoms who tend to be highly cognitive individuals, likely holding a negativity bias and less motivated and open to new concepts, might experience the body scan practice as more challenging to engage with.

Considering anxiety, the body scan might then not only benefit sleep related anxiety but extend towards other areas of worry and vice versa. Previous research has supported the view that body scan integrative interventions and mindfulness sleep interventions for adolescents with anxiety have benefitted anxiety symptom reduction (Blake et al., 2018; Crowley et al., 2017). A reduction of physiological and mental hyperarousal before sleep through the body scan is thought to cause these improvements, in line with for example the psychobiological model of sleep regulation (Dahl, 1996). Moreover, insomnia has been shown to have a bidirectional relationship with anxiety (Dahl, 1996; Kelly & El-Sheikh, 2014). In this case a reduction of either anxiety symptoms (sleep related or not) through the body scan, might reduce symptoms of the other and result in a positive spiral.

These moderating effects of anxiety have, however, only been found for self-reported insomnia symptoms, not in sleep parameters measured by actigraphy which were objectively generated without participant's direct reporting. A review by Goupil and Bekinschtein (2012) on cognitive processing in the transition to sleep highlights a gradual reduction in consciousness and responsiveness to the environment already beginning during the falling asleep process and sleep onset. This successive transition through states decreasing in conscious awareness include loss of thought coherence and control (Yang et al., 2010).

In the body scan group during the initiation of sleep, the last conscious attention and processing might have been related to the body scan, whereas the activities and states recorded by actigraphy after sleep onset have not been consciously registered. What these participants might have consciously noticed then is the calming effect of the body scan on mental and physical activity, leading to an improved experience of the falling asleep process, usually characterized by excessive worry and tension. The process of sleep initiation has been shown to be especially problematic in adolescence (Gradisar et al.,

2011) and an improved perception of this aspect could have led to a self-report of less insomnia symptoms, not otherwise shown in actual actigraphy measures. However, results only indicate a trend, which is why they should be interpreted with caution. It must again be mentioned that two separate analysis were done for anxiety and depression, possibly contributing to dependence between outcomes and covariates. Anxiety and depressive symptoms at baseline appear not to influence body scan effectiveness in CBT-i, highlighting equal applicability for adolescents with both cooccurring symptoms. The body scan then serves as an important treatment tool across symptom profiles, as it has been shown to contribute to improving characterising insomnia facets, such as wake after sleep onset and sleep efficiency. Integrating the body scan in CBT-i accounts for directed treatment efforts towards insomnia treatment in adolescents.

Strengths and Limitations

The present study is a secondary analysis to a large longitudinal randomized control trial with objective and subjective measures respectively, while including the novel concept of the body scan in internet delivered CBT-i therapy. There are nonetheless some limitations in this study design. As the greater study did not specifically research the body scan component in itself, BS and NBS groups were not randomly assigned but self-assigned by choosing the body scan freely, even though all participants were encouraged to engage in the body scan. This might have indicated greater openness and readiness towards the body scan, thereby possibly produced an underlying confounding factor when comparing the groups. However, both groups participated similarly in other treatment components, indicating equal overall treatment engagement.

Participants of this study were 80% female, which might have contributed to study outcomes by over-emphasising gender effects. In other studies implementing mindfulness based interventions, a gender difference in attitude towards these practices has been detected. More specifically, boys tended to show greater negative outcome expectations and criticism compared to girls (Beattie et al., 2020). Even though these aspects of the research design can be potentially confounding, findings can also point towards a difference in readiness and motivation to engage in the mindfulness body scan in adolescents.

Furthermore, this study was conducted via the internet only. Especially when engaging in meditation or mindfulness practices such as the body scan, an in-person group atmosphere could have had different effects. Mindfulness interventions have previously been associated to symptom improvements especially when done in a group setting (e.g., Crowley et al., 2017). Performing the body scan in a group setting with peers experiencing relatable issues might have created a more supporting group atmosphere and motivation. Seeing examples of peers who practice the body scan could promote its practice in more critical individuals. Groups give the opportunity to speak about experiences and concepts with trainers or peers, potentially making the experience of the body scan more whole and integrative. As stated above, effectiveness of the body scan is benefitted by openness and non-judgement further leading to full engagement, which could have been benefitted by feeling as a member of an in-group that is creating a shared experience. This might however have challenged the possibility to choose freely when to engage in the body scan or not. The body scan could also not have been done immediately before going to bed.

Future Research

As results display conflicting findings, further research is necessary to validate the assumptions drawn from this study. CBT-i has only recently been researched for its appliance in adolescents with insomnia, and further in-depth investigation of different patient characteristics and preferences is necessary. The body scan might be more effective for certain symptom characteristics of depression, anxiety, and insomnia, where some patients can benefit more from its inclusion than others. This might differ in terms of individual symptomatic problems that are most pressing, or between self-reported and objectively assessed insomnia symptoms. Whether the inner attitude and openness toward the body scan or other mindfulness techniques changes outcomes in treatment effectiveness has yet to be determined. Comparing participants who voluntarily wish to use the body scan to a randomly assigned group in both self-reported and objectively derived measures of insomnia, as well as intensity of application can help answer this question. Whether the timing or setting of the body scan has different effects on adolescents is also subject to further research. Especially future randomized control trials are recommended to increase study validity.

The body scan is yet one of many meditation and mindfulness techniques explored within insomnia treatment. There is a difference in explaining the levels mindfulness meditations operate by; some suggesting a more cognitive relaxation while others suggest bodily relaxation. Research seems to point to a great degree towards the role of bodily and mental arousal, addressed by the body scan. It has also been suggested that the stillness of lying in bed during the body scan can be a frustrating reminder of insomnia factors. If the psychobiological model holds true, other body-mind interventions such as yoga for example, a form of movement meditation operating more obviously on the level of the body, could be included as a comparison condition. Many CBT-i methods focus on removing stimuli, such as screen time or time in bed. Exploring other strategies, or even multiple to choose from, that can be applied before bed can provide beneficial strategies for healthy bedtime routines.

Conclusion

Previous research demonstrated CBT-i effectiveness for adolescents with insomnia. The mindfulness-based body scan as part of CBT-i has been investigated more closely in a study by De Bruin and colleagues (2020) and shown especially effective in improving objective insomnia factors of wake after sleep onset when compared to adolescents who decided not to use the body scan. The present study aligns with these previous findings and found additional improvements in sleep efficiency in the body scan group. A trend in body scan effectiveness for self-reported insomnia symptom reduction for adolescents with insomnia and cooccurring anxiety at baseline has been identified. Objectively assessed insomnia symptoms of sleep onset latency, wake after sleep onset, and sleep efficiency do not show this difference between groups. Overall, results appear to show equal compatibility of the body scan for adolescents with insomnia with both, cooccurring depressive and anxiety symptoms. This highlights the body scan's importance in CBT-i treatment as it accounts for considerable improvements in insomnia symptoms. With the body scan being a rather novel concept in CBT-i, differences in patient characteristics and attitudes as well as clearer accounts for the mechanisms behind symptom improvement is needed. Future research is urged to investigate differences in motivation and openness toward body

scan use in female and male adolescent patients and compare different mindfulness strategies to highlight underlying mechanisms.

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