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ACT for sleep - Internet-delivered self-help ACT for sub-clinical and clinical insomnia: A
Randomized Controlled Trial

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ACCEPTED MANUSCRIPT

Abstract

Background: Sleep disturbances are a common health problem. New and more accessible alternatives are needed to improve the availability of psychological treatments for insomnia.

Objective: The aim of the present study was to investigate the effects of a self-help Acceptance and Commitment Therapy-based web-intervention for sleep disturbances.

Method: Participants ($N=86$) reporting symptoms of insomnia were randomly assigned to an Internet-delivered ACT (iACT, $n=43$) or a control condition (WLC, $n=40$) and assessed with standardized self-report measures related to sleep (ISI, BNSQ, ESS, DBAS), psychological symptoms (BDI-II, SCL-90), life satisfaction, and ACT-related processes (AAQ-2, FFMQ, and WBSI) at pre- and post-measurement, and at 6-month follow-up (iACT group only). Participants in the study condition received a 6-week Internet intervention based on the processes of ACT, enhanced with weekly automated email-based reminders. No therapist support was offered during the intervention.

Results: Hierarchical linear modeling analysis showed significant differences between the treatment and the control group in sleep quality and duration (BNSQ), sleep-related dysfunctional cognitions (DBAS), and severity of depressive symptoms (BDI-II) from Pre to Post-measurement in favor of the intervention group. The intervention showed also significant positive impact on thought suppression (WBSI), but no effect on general psychological flexibility and mindfulness. The between group effect sizes at Post were moderate or small ($d = 0.21-0.53$). In the iACT group, changes achieved in sleep quality and duration, symptom measures and suppression of thoughts during the intervention were maintained during the 6-month follow-up period.

Conclusions: We conclude that unguided Internet-delivered Acceptance and Commitment Therapy can be effective in treating symptoms of insomnia and offers a useful addition to existing treatment options.

Keywords: ACT; insomnia; sleep disturbances; web-based; unguided self-help; randomized controlled trial

INTRODUCTION

Complaints of insomnia, such as difficulty in falling asleep and in maintaining sleep, waking up too early or non-restorative sleep are highly prevalent. It is estimated that about 30% of the population report symptoms of insomnia, and about 10% meet the diagnostic criteria for insomnia disorder (Mai & Buysse, 2008). The long-term effects of sleep loss and sleep-related disorders are associated with a range of adverse health consequences, including both psychiatric and chronic medical conditions such as depression, hypertension, diabetes, and obesity (e.g., van Mill, Hoogendijk, Vogelzangs, van Dyck, & Penninx, 2010).

Despite the high prevalence of insomnia and sleep disorders, only a minority of persons suffering from this detrimental condition are treated (e.g., Morin, LeBlanc, Daley, Gregoire, & Mérette, 2006). One of the most effective non-pharmacological treatments for insomnia is Cognitive Behavior Therapy (e.g., Morin, 2004; Morin et al. 2006), which has been found effective in both the short and long term (Okajima, Komada, & Inoue, 2011) and in group format (Blom et al., 2015; Koffel, Koffel, & Gehrman, 2015), indicating medium to large effect sizes both at treatment end and follow-up. Internet-delivered CBT for insomnia (CBT-I) has proved effective and acceptable in different populations (e.g, Zacharie, Lyby, Ritterband, & O'Toole, 2016).

Typically, a CBT-I intervention consist of weekly sessions over 6-8 weeks and includes several stimulus control instructions (e.g. sleep only in the bedroom, leave the bed when awake for approximately 10-20 min), sleep restriction instructions (e.g. establish a fixed wake time and decrease sleep opportunities) and sleep hygiene instructions (e.g., do not try to fall asleep, avoid excessive liquids and alcohol in the evenings). Of these, stimulus control therapy is considered as

the first-line intervention (Pigeon & Perlis, 2008). Also, interventions such as relaxation training, phototherapy and cognitive therapy could be included in the treatment. Recently, research suggests that the nighttime and daytime symptoms of insomnia might be maintained, and even exacerbated, by various psychological mechanisms and factors (Jansson-Fröjmark, Harvey, Norell-Clarke, & Linton, 2012). Monitoring one's body sensations during the daytime may lead to rumination and maintain the insomnia. Recent findings also indicate that rumination and worry might be central processes in insomnia, predicting increased sleep disturbance (Mc Gowan, Behar & Luhmann, 2016; Sunhed & Jansson-Fröjmark, 2014); therefore, interventions targeting worry and rumination are warranted. Acceptance and mindfulness-based interventions offer adaptive ways of working with unhelpful beliefs, worry and rumination associated with daytime and nocturnal symptoms of insomnia. One treatment approach applying mindfulness, acceptance and value-based techniques is Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 2012).

Several studies have found ACT to be an effective, or likely to be effective, form of treatment for a wide range of psychological disorders (e.g., A-Tjak, Davis, Morina, Powers, Smits, & Emmelkamp, 2015; Ruiz, 2010, 2012). Self-help treatments based on ACT are emerging, including Internet-based treatments and mobile applications for a number of health and mental health concerns (e.g., French, Golijani-Moghaddam & Schröder, 2017). ACT-based Internet-delivered treatments have been developed for chronic pain (Buhrman, Skoglund, Husell, Bergström, Gordh et al., 2013; Trompetter, Bohlmeijer, Veehof, & Schreurs, 2015), fibromyalgia (Ljótsson, Atterlöf, Lagerlöf, Andersson, Jernelöv et al., 2014), tinnitus (Hesser, Gustafsson, Lundén, Henrikson, Fattahi et al., 2012), depression (Lappalainen, Granlund, Siltanen, Ahonen, Vitikainen, Tolvanen, & Lappalainen 2014; Lappalainen, Langrial, Oinas-Kukkonen, & Tolvanen, 2015), well-being of university students (Levin, Pistorello, Seeley, and Hayes, 2014; Räsänen, Lappalainen, Muotka, Tolvanen, & Lappalainen, 2016), social anxiety (Yuen, Herbert, Forman, Goetter, Comer, & Bradley, 2013), smoking cessation (Jones, Heffner, Mercer, Wyszynski, Vilardaga, & Bricker,

2015) and physical activity (Moffitt & Mohr, 2015). However, only a few studies have investigated the use of ACT to treat sleeping difficulties. Baik & O'Brien (2013) and Baik (2015) have provided preliminary data on the acceptability and effectiveness of ACT for treating insomnia. A pilot study by Åkerlund, Bolanowski and Lundh (2004) of an ACT-inspired group treatment protocol has also yielded promising results. Recently, Zetterqvist et al. (2018) evaluated an acceptance-based behavioral group treatment for insomnia for patients with longstanding pain. Results showed significant improvements in most outcomes at post-treatment and results were maintained at follow-up.

Dalrymple et al. (2010) described how principles of ACT can be integrated in CBT-I, suggesting that this approach would be particularly useful for those who do not benefit from CBT-I. According to Dalrymple et al. (2010), ACT may be useful for the treatment of insomnia by, for instance, increasing willingness to let go of trying to control sleep. Although, some intervention methods are similar in CBT-I and ACT, compared to CBT-I, ACT is a more process- or principle-based form on CBT, focused on increasing psychological flexibility skills, and uses acceptance, mindfulness and behavioral activation techniques. The clinical model of ACT is typically described in six main processes: identification of values, value-based actions, mindfulness, acceptance, defusion and contextual view of self. In addition, therapists applying ACT-principles try to keep away from giving direct instructions, and instead uses experiential and mindfulness exercises, and different defusion techniques (Hayes, Villatte, Levin & Hildebrandt, 2011).

Inspired by the above-mentioned studies, we investigated whether an unsupported, Internet-delivered ACT approach would have an impact on distress caused by impaired sleep. An unsupported web-based intervention for sleep disturbances would be a cost-effective and valuable tool which could easily be disseminated to a larger audience. The current study includes also participants with subthreshold insomnia. It has been recognized that much research on insomnia is performed in highly selected patient samples which do not reflect 'real-world' patients. It is

important to include ‘real world’ patients since many of them do have physical and psychiatric comorbidity (Van Straten and Cuijpers, 2009).

Our hypothesis was that Internet-delivered ACT treatment combined with automatic email-based reminders would significantly impact the perceived severity of insomnia and scores across a range of additional symptom and process measures. Given the likelihood that ACT is an effective treatment for depression and anxiety, and the correlations found between insomnia and diverse psychological disorders, we expected the intervention to increase not only sleep quality, sleep-related dysfunctional cognitions about sleep but also psychological and somatic symptoms among the study participants. Therefore, we investigated whether a self-help Internet-delivered treatment based on the principles of ACT would have a positive impact on symptoms of insomnia, psychological and physiological symptoms, and on distressing thoughts related to insomnia as measured by instruments assessing psychological flexibility, mindfulness, and thought suppression. Considering that personal therapist contact was not included, we hypothesized that the intervention effect size compared to a no-treatment control, would be small to moderate. This assumption was based on the earlier findings indicating that treatments offered with therapist support yield better results in the form of larger effect sizes than fully automated web-based treatments (e.g., Johansson & Andersson, 2012).

METHOD

Participants

The study was conducted between October and November 2013. Advertisements for volunteers were placed in local newspapers in the cities of XXX and XXX, XXX. The advertisements stated that we were looking for individuals suffering from sleep difficulties. Adults aged 18 or older reporting sleep difficulties were eligible for the study if they met the following criteria: 1) at least subthreshold insomnia (total score of at least 8 on the Insomnia Severity Index

(ISI; Bastien, Vallières, & Morin, 2001), 2) access to Internet/email, 3) no lengthy breaks (such as trips lasting longer than one week) during the intervention, 4) access to a telephone, 5) no current psychological or other treatment for sleep disorders 6) XXX as native language. In total, 122 individuals contacted the XXX Clinic at the XXX of XXX, XXX of XXX via telephone or email, and were screened through a structured telephone interview conducted by two research assistants. As result of the screening, 14 of the persons screened did not fulfil the eligibility and thus were excluded from the study. A further 22 eligible persons were not included in the study because we were unable to organize the measurements to all those interested in participating in it. Hence, the final number of participants was 86 ($n = 86$). Participants were randomly assigned to either the Internet intervention (iACT, $n = 43$) or the Waitlist condition (Control, $n = 43$) using simple randomization method and a randomizing tool (<https://www.random.org/lists/>). A person not involved in the study performed the randomization. Pre-measurement packages, including information about the study as well as an informed consent form, were sent to all participants by regular mail. Three participants (7% out of 43) in the control condition did not return the pre-measurement package, and thus the final number of participants in the study at the pre-measurement stage was 83 (iACT, $n = 43$; WLC, $n = 40$). All randomized participants who had returned the pre-measurement package and for whom a signed informed consent was obtained were included in the analyses ($n = 83$). The flow diagram is presented in Figure 1. The wait-list controls were offered the same self-help program after the control period (post-measurement).

The study was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The study was approved by the Ethical Committee at the XXX of XXX, XXX. The RCT guidelines were followed throughout the study, however, the trial was not registered in the ClinicalTrials.gov Protocol Registration.

Figure 1 in here

At pre-assessment, participants were asked for demographic information including medication and earlier treatment for sleeping problems. Participant characteristics are presented in Table 1. The mean age for all participants was 53 years (range 22-79). The groups showed a statistically significant gender difference (chi-square 4.31, $df = 1$, $p = 0.043$). In the intervention group, females were in the majority (females, 74%; males, 26%), whereas both sexes were more equally represented in the WLC condition: females 53% compared to males 47%. No other significant differences were observed between the groups at baseline regarding the demographic and relevant outcome variables (variables are described later). Nearly 60% of all participants were highly educated (iACT, 61%; WLC, 56%). 35% of the participants had previously been treated for sleeping problems. Half of the participants (45%) were using sleep medication. In the initial telephone assessment interview, severity of insomnia was assessed with the Insomnia Severity Index (ISI). Participants' ISI total scores indicated moderate severity of clinical insomnia in both groups at pre-measurement ($M = 16.96$, $SD = 4.12$, $n = 83$; ISI = 15–21 considered as clinical insomnia of moderate severity, see measures). Based on ISI, 71% of the participants reported moderate or severe insomnia (Table 1). As measured by the BDI-II, 35 % of all participants ($n=29/83$) reported at least mild depression (iACT, $n = 40$ %; WLC, $n = 30$ %).

Table 1 in here

Procedure

Participants were asked to complete questionnaires at pre and post-treatment (iACT, Control) and at 6-month follow-up (iACT). The pre-post comparison investigated whether the self-help iACT intervention had been effective in comparison to the no-treatment control condition (Control). The 6-month follow-up studied the maintenance of the intervention effects in the iACT group only. At pre-measurement, participants received the questionnaires via regular mail and returned them along with the informed consent form. When the measurement package had been received by the researchers, participants in the intervention group were provided with a URL to the

program, including user name and password, and granted access to the self-help program on the Internet. The post-measurement was conducted 7 weeks after the start of the intervention. The measurement package was sent to participants by regular mail and they were asked to fill it in and bring it to the final interview. The aim of the final in-person interview conducted after the post-measurement was to obtain information about how participants experienced the program. The iACT participants were contacted at the 6-month follow-up and asked to complete the same questionnaires again. Control participants were given access to the program following the post-assessment but no follow-up data were collected.

Intervention

The structure and the basic model of the intervention was based on our earlier web-based interventions that have showed low drop-outs and good adherence to our iACT online programs (xxx et al., xx; xxx et al. xx). The 6-week long Internet intervention (Table 2) was implemented using a website that did not include any interactive elements or individual tailoring. There was no tracking or monitoring in terms of whether users actually completed the tasks they were provided. No email, telephone or any other personal support was offered during the intervention. Instead, two email-based automated reminders were sent every week. A short page of information (300 words) including 12 sleep hygiene and behavioural instructions was available in the web-program: sleep hygiene instructions (e.g., get up at same time of each day), two stimulus control instructions (e.g., leave the bedroom/bed when awake for approximately 10-20 min; Pigeon & Perlis, 2008), and three ACT-based instructions (e.g., pay attention to day time routines possibly affecting your sleep and, for example, take a break and practice mindfulness). The intervention program comprised 6 modules, based on the processes of ACT (Hayes et al, 2012). Each module – which was instructed to be processed within a week – included text, experiential audio exercises (n = 11) and video clips (n = 6) aiming at enhancing mindfulness and acceptance skills, psychological flexibility and

commitment towards value-based actions. The first module introduced values and value-based actions, inviting participants to shift their focus from struggling with their sleeplessness and “sleep monster” to what is truly meaningful for them in life, and encouraging them to take actions and make behavioural changes in line with their values and goals. The second week was devoted to teaching participants mindfulness, the ability to mindfully observe their unwanted thoughts, feelings, and sensations, without becoming entangled in or judging them. This was done, for instance, by introducing audio exercises such as *Mindful Breathing* or *Mindful Sitting*. The third week’s theme was cognitive defusion which refers to the ability to see thoughts and feelings for what they are: just thoughts and emotions, and creating a distance to them, rather than becoming overly fused with them or letting them take control. For this purpose, exercises such as *Labelling Thoughts* or *Observing the Stream of Thoughts* were deployed. The fourth week focused on Self-as-Context, introducing the observer stance using, for instance, the *Observer exercise*. Finally, the goal of the fifth week was to promote an attitude of acceptance via a range of exercises guiding the participants to adopt a more accepting attitude towards distressing thoughts. The 6th module summed up the whole program. Table 2 presents a brief overview of the ACT themes used in the program.

Table 2 here

Each week, participants were instructed to complete one ACT-based module and related exercises, before moving forward to the next module the following week. They were also advised to fill in an online sleep diary with nine questions each day during the first and the last week of the study. Participants were also asked to comment on the weekly assignments and the experiences gained from them and write their comments in a space provided on the Internet platform. They did not receive any feedback on their comments and reflections. Each week, two email-based automated

reminders were sent out to the participants. The first reminder was sent to notify participants that they could now access the next module, and the second reminder was sent to motivate users to persevere in implementing the strategies learned. An example of a reminder is given below (Week 2, Reminder 2):

Dear User, we hope that you have successfully completed the second week's task. This is a polite reminder to practice the skills that you have learnt. Try the exercises out and apply them in your daily life.

We'll be in touch next week!

Sleep study team

The ACT-based self-help program was developed by the research team at the XXX of XXX, XXX of XXX, while the technical design and implementation of the program was the responsibility of the research group from the XXX of XXX, XXX of XXX.

Measures

Main outcome measure

The Basic Nordic Sleep Questionnaire (BNSQ; Partinen & Gislason 1995) was used as main outcome measure to assess sleep quality, sleep duration during the night, sleep and waking time, daytime drowsiness and snoring. The BNSQ is a 25-item self-report measure in which each item is rated on a 5-point Likert scale from 1 (never or less than once per month) to 5 (every night or almost every night) showing on how many nights/days per week an individual experiences sleep-related distress. The total score ranges from 7 to 35. Higher scores indicate poorer quality of sleep, fatigue, or more severe snoring and interrupted breathing.

Secondary outcome measures

The Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001) was mainly used for screening purposes and to provide a quantitative index of sleep severity symptoms. To be included in the study, a total ISI score of at least 8 was required. The ISI is a self-report inventory measuring current symptoms of insomnia. This 7-item scale measures the perceived severity of insomnia symptoms, distress, and daytime impairment. Each item is rated on a five-point scale ranging from 0 to 4. The total score ranges from 0–28, where 0–7 indicate no clinically significant insomnia, 8–14 subthreshold insomnia, 15–21 clinical insomnia of moderate severity, and 22–28 severe clinical insomnia.

Sleeping difficulties were also assessed by the Epworth Sleepiness Scale (ESS), which is a self-administrated eight-item questionnaire (Johns, 1991) measuring the level of sleepiness during the daytime (Johns, 1991). Each item has four response options estimating how the individual inadvertently dozes off when engaged in activities involving low levels of stimulation (0–3; would never doze, slight chance of dozing, moderate chance of dozing and high chance of dozing). The total score ranges from 0–24. ESS scores greater than 16 indicate a high level of daytime sleepiness. The ESS has proven to be reliable and internally consistent according to Johns (1991).

The Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS) developed by Morin & Espie (2003) is an instrument that discriminates individuals with insomnia from normal sleepers. The DBAS measure dysfunctional beliefs and attitudes about sleep and comprises 16 questions to be answered on a Likert scale from 0 to 10 (0=Strongly Disagree, 10=Strongly Agree). High scores indicate a greater number of dysfunctional beliefs and attitudes about sleep. The maximum score is 160.

Participants' insomnia symptoms were assessed through a sleep diary consisting of nine questions about the amount and quality of sleep (e.g., At what time did you go to bed? Did you

get enough sleep?). Participants kept the sleep diary during the first and the last week of the intervention.

Depressive symptoms were measured by the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 2004), which comprises 21 questions on depressive symptoms and their severity. The scale ranges from 0–63, where scores of 0–13 indicate no or few depressive symptoms, 14–19 mild depression, 20–28 moderate depression and 29–63 severe depression). The BDI-II has been shown to have reliability and validity in both nonclinical and clinical populations and high internal consistency (Cronbach's alpha $\alpha=.92$; Segal, Coolidge, Cahill, & O'Riley, 2008).

Psychological and physiological symptoms were assessed with the Symptom Checklist 90 (SCL-90; Holi, Sammallahti, & Ahlberg, 1998), which is a self-report checklist with 90 questions on a scale of 0 (none) to 4 (very much). Each item is rated on a five-point scale of distress from 0 (none) to 4 (extreme). In a XXX community sample ($n=337$; Holi et al., 1998), the mean SCL-90 score, reported as the General Severity Index (GSI), was 0.60 ($SD=0.44$). In this study, the SCL-90 scores are also reported as GSI values (the mean value across all items). The internal consistency of this construct has been observed to be high (Cronbach's alpha $\alpha=0.96$) in other studies (XXX, XXX, XXX, XXX, XXX, & XXX, 2018). A lower score indicates fewer symptoms.

The XXX Descriptive Visual Rating scale (Ojanen & Seppälä, 1996, Ojanen, 2001), used to measure life satisfaction, has been shown to have good test-retest reliability (Sjögren, Nissinen, Järvenpää, Ojanen, Vanharanta, & Mälkiä, 2005). Participants were asked to rate on a scale of 0 to 100 (0=very dissatisfied, 100=very satisfied) how satisfied they were with their lives during the previous month. A higher score indicates greater satisfaction with life.

Psychological flexibility was measured with the Acceptance and Action Questionnaire (AAQ-II; Bond, Hayes, Baer, Carpenter, Guenole, Orcutt, Walz, & Zettle, 2011), which measures experiential avoidance with 7 questions to be answered on a scale of 1 (never true) to 7 (always

true) on the participant's willingness to be in contact with negative private events, acceptance of these events, and whether they can live in accordance with their values. Sum scores range from 7 to 49, a lower score indicating a higher level of psychological flexibility, e.g. higher acceptance and less EA.

Mindfulness was measured by the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, & Hopkins, Krietemeyer, & Toney 2006), which is a self-report inventory for the assessment of mindfulness skills. In this study, the sum score of the FFMQ was used to assess five mindfulness skills: observing, describing, acting with awareness, non-judging, and non-reactivity. FFMQ contains 39 statements that need to be answered on a scale of 1 to 5 (1=never or very rarely true; 5=very often or always true). A higher score indicates a higher level of mindfulness skills (min 39, max 195).

The White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994) was used to assess thought suppression. Chronic thought suppression is related to obsessive thinking and negative affect associated with depression and anxiety. The WBSI can be used as a measure of lack of acceptance. The 15-item WBSI is scored on a 5 point-scale from strongly disagree (1) to strongly agree (5). The total score, ranging from 15 to 75, is obtained by summing the scores for the individual items. Higher scores indicate greater tendencies to suppress thoughts.

Treatment adherence, satisfaction and willingness to recommend the program

To measure adherence, participants in the treatment group were asked at post-treatment how many hours per week they had spent on the web-based treatment program. The options were 1) under 30 minutes, 2) 30 minutes–1 hour, 3) 1–2 hours, 4) 2–3 hours, and 5) over 3 hours.

Data on treatment satisfaction and willingness to recommend the web-based program were collected at post-treatment. Participants in the treatment condition rated their satisfaction with treatment on a 10-point Visual Analogue scale ranging from 1 to 10 (1=not at all satisfied with the

treatment, 10=very satisfied with the treatment). In addition, using the same 10-point scale (1=would not recommend at all, 10=would very highly recommend), participants were asked if they would recommend this kind of program to others. At the 6-month follow-up, they were asked whether or not (yes or no) they would recommend the treatment to others. Higher scores represent greater satisfaction and a higher recommendation rating.

Statistical analysis

Pre-measurement differences between the groups were examined using *t*- and chi-square tests. Analyses of the intervention effects were performed with the Mplus statistical package, using hierarchical linear modeling (HLM) with the full information maximum likelihood (FIML) estimation method. All the available information was used in the analyses and missing data was assumed to be Missing at Random (MAR). Thus, all randomized participants who had completed the pre-measurement were included in the analyses. The between-group differences investigating whether the iACT and WLC groups changed differently were investigated from pre- and post-measurement. Within-group changes in the iACT group were investigated from the pre- to post-measurement and to 6-month follow-up. The pre to post group x time interaction and the pre-post follow-up were tested with the Wald test (W). In addition, the number of participants (%) in the iACT group categorized to have subthreshold, moderate or severe insomnia at pre and follow-up measurements were reported (n = 43). The drop-outs were categorized belonging to the pre-measurement category (no treatment impact).

Effect sizes (ES) were reported using *d*-values. The between-group ES was calculated at post treatment by dividing the difference between the intervention group mean and control group mean by the pooled standard deviation of the two groups. To take into account a possible lack of pre-test equivalence, post ES values were corrected by the pre-measurement difference. The within-group ES was calculated for the pre- and follow-up measurements by dividing the mean change from the pre-measurement by the pooled standard deviation (SD) (Feske & Chambles, 1995; Morris

& DeShon, 2002). A between-group ES of 0.2 was considered small, 0.5 medium, and 0.8 large, while the corresponding within-group ES values were 0.5, 0.8, and 1.1. Based on our earlier study (xxx et al., 2015) investigating the effect of an online ACT intervention for depression symptoms with minimal support, we estimated that total sample size around 60 would produce between effect size equal to 0.60 (with a power of 0.80 and $\alpha = 0.05$).

Results

Adherence to the assessments

At post-measurement, data were obtained from 93 % of the participants ($n = 77$; 95 % in the iACT intervention, and 90% in the WLC condition). The dropout rate from pre- to post-assessment was 7 %, and at the 6-month follow-up, the dropout rate for the iACT group of 9 % ($n = 39$). Participants dropped out without providing reasons for doing so (total $n = 8$). Most participants who dropped out reported moderate insomnia problems at pre-measurement (iACT, drop-out at post, $n = 2$, and drop-out at follow-up, $n = 1$; WLC, drop-out at post, $n = 3$). Both in the iACT and WLC groups one participant who dropped out belonged to the severe insomnia category. Participants in the WLC condition were offered the same intervention after completion of the post measurements and, consequently, did not participate in the 6-month follow-up.

Primary outcome (pre to post)

First, we investigated whether the groups changed differently over time from pre- to post-measurement. The primary outcome measure, the Basic Nordic Sleep Questionnaire (BNSQ), assessing quality and duration of sleep and daytime drowsiness, showed significantly different change patterns between the groups, with the Internet group (iACT) reporting a significant improvement compared to WLC in the quality and duration of sleep from pre- to post-assessment (BNSQ: Wald test (W) = 6.71; $df = 1$; $p = 0.001$). However, the between-group effect size (ES) was small ($d = 0.42$); see Table 3.

Secondary outcomes (pre to post)

The iACT intervention had a significantly larger impact on dysfunctional beliefs and attitudes about sleep as measured by the DBAS ($p = 0.001$). Second, the intervention had a significant positive impact on depression as measured by the BDI-II ($p < 0.001$). Nearly significant change was seen in favor of the iACT group in psychological and physiological symptoms (SCL-90; $p = 0.072$). Furthermore, the intervention significantly reduced thought suppression (WBSI; $p = 0.047$). No significant changes between the groups were observed in daytime sleepiness (ESS) nor was there a significant impact on psychological flexibility and mindfulness (FFMQ) total score neither on different subscales of FFMQ (Table 4, subscales not shown). Because of extensive missing data in the online sleep diary, the data was unreliable and inaccurate, and, therefore, could not be analyzed.

Regarding the between group effect sized at post-measurement, dysfunctional beliefs and attitudes about sleep indicated a medium-sized between-group difference (DBAS, $d = 0.53$) in favor for the iACT group (Table 3). The between-group effect sizes on the symptom measures were small (BDI, $d = 0.47$; SCL-90, $d = 0.30$; Satisfaction with Life, $d = 0.23$). Among the process measures (Table 4), a small effect size between the groups was observed for thought suppression (WBSI, $d = 0.30$), while the other process measures showed no between-group effect (AAQ-II, $d = 0.01$; FFMQ, $d = 0.10$ for the total score, $d = 0.03 - 0.13$ for the subscales).

The participants categorized having clinical insomnia at pre-measurement based on The Insomnia Severity Index (ISI, total score > 14), were analyzed separately. Compared to the control group ($n = 21$), the iACT group ($n = 32$) had a significantly larger change in quality and duration of sleep (BNSQ, $p < 0.05$, between group $d = 0.48$), dysfunctional beliefs and attitudes (DBAS, $p < 0.01$, $d = 0.75$), symptoms of depression (BDI-II, $p < 0.01$, $d = 0.58$), and thought suppression (WBSI, $p < 0.05$, $d = 0.51$). No intervention impact was obtained for ESS ($d = 0.08$), SCL-90 ($d = 0.40$), Life satisfaction ($d = 0.26$), AAQ-II ($d = 0.05$) and FFMQ ($d = 0.03$).

6-month follow-up

From the pre-measurement to 6-month follow-up, significant changes were observed in the iACT group in several measures (Tables 3 and 4). The main outcome measure, the quality and duration of sleep (BNSQ), had improved significantly, as well as insomnia severity (ISI), sleepiness (ESS), and dysfunctional beliefs and attitudes about sleep (DBAS). Furthermore, among the symptoms, depressive symptoms (BDI-II), and psychological and physiological symptoms (SCL-90) decreased significantly from pre to follow-up, and life satisfaction increased significantly. Of the process measures, only suppression of distressing thoughts showed a significant decrease from pre- and 6-month follow-up measurement (WBSI). However, the within-group effect sizes from pre to 6-month follow-up (iACT) remained small for most measures ($d = 0.23$ – 0.71), except insomnia severity (ISI), where a large within-group effect size was found (ISI; $d = 1.27$). In the iACT group, 38 % of the participants were categorized to have moderate or severe insomnia at follow-up compared to 79 % at pre-measurement. At follow-up, 30 % of the participants in the iACT group reported no significant insomnia compared to 0 % at beginning of the intervention. These numbers include all participants in the iACT group ($n = 43$), and drop-outs were categorized belonging to the same category as at pre-measurements (no treatment impact). In the iACT group, of those participants classified as having clinical insomnia ($n = 34$) at pre-measurement, only 35% were categorized having clinical insomnia at follow-up (drop-outs included in the percentage).

Adherence to the online program and satisfaction

The majority (63%, $n=27$ out of 43) of the participants had spent one hour or more weekly on the program; 35% ($n=15$) had spent 1-2 hours, 21% ($n=9$) 2-3 hours, and 7% ($n=3$) over 3 hours. Participants expressed a moderate level of satisfaction with the program after completing it (at post treatment). However, there was wide variation between the participants. The mean

satisfaction score was 6.98, ranging from 2 to 10, on a scale from 1–10 (1=not at all satisfied with the treatment, 10=very satisfied with the treatment). In addition, using the same 10-point scale, participants were asked if they would recommend the program to others. The mean rating was 7.78, ranging from 2 to 10. At the 6-month follow-up, the mean satisfaction level continued to be on a relatively high level (7.03). Further, at the 6-month follow-up, the great majority would recommend the program to others (86%).

Discussion

The study investigated the efficacy and feasibility of using the Internet to deliver a 6-week long unsupported ACT intervention for adults suffering from sleep disturbances (including both subthreshold and clinical insomnia) compared to a wait-list control group. The study indicated that an ACT-based intervention delivered via the Internet without therapist contact for adults with sleeping disturbances can improve quality of sleep and sleep-related distress. Significant improvements were seen for quality and duration of sleep (BNSQ), and sleep-related dysfunctional beliefs and attitudes (DBAS). In addition, the intervention decreased depressive symptoms (BDI-II) and impacted significantly thought suppression (WBSI). Separate analyses showed that the iACT self-help program had significant effect on these measures also when investigating those participants who reported clinical insomnia. During the 6-month follow-up, the intervention group showed maintenance of changes induced during the intervention, including sleep-related measures, depression, psychological and physiological symptoms, life satisfaction, and thought suppression. In line with our hypothesis, the intervention, owing to the absence of therapist contact, showed, as expected, small to moderate effects. However, although the self-help iACT online program had an impact on thought suppression, it had no effect on general psychological flexibility and mindfulness. This observation recalls further research on the relevant processes associated with insomnia. Overall, the results suggest that an Internet-delivered self-help program based on ACT

may be an effective first-step procedure or a useful addition to existing treatment options in assisting adults with sleep disturbances.

These findings contribute to the small but growing research on brief and Internet-based ACT interventions. The results are in line with those of earlier research based on CBT interventions, suggesting that effect sizes for unsupported self-help treatments for insomnia are moderately effective, demonstrating small to moderate effects on sleep ($d = 0.36$) and on depression ($d = 0.51$) at post-treatment (van Straten & Cuijpers, 2009). An example for an intervention for insomnia consisting of a self-help book is a CBT-based self-help intervention in which the unsupported bibliotherapy group demonstrated a large within-group effect size in insomnia severity from pre-measurement to follow-up (ISI, $d = 1.43$; Jernelöv et al., 2012). Our finding at the equivalent measurement point is in line with this result (ISI, $d = 1.27$ pre-f-up). However, it is possible that in purpose to obtain larger effect sizes, self-help online interventions need to be longer than 6 weeks as investigated in the current study.

Another issue is the comorbidity that often goes hand in hand with insomnia and disturbed sleep. Van Straten & Cuijpers (2009) point out that it is important that “normal” patients, who often suffer from both psychological and physical co-morbid problems, are included in insomnia interventions. Therefore, an optimal treatment for insomnia should not only be effective on sleep-related measures but also on psychological symptoms, such as depression (van Straten & Cuijpers, 2009). Our sample was not restricted to individuals without co-morbidities. Instead, it consisted of “real world” media-recruited participants, nearly 24% of whom were categorized as depressed when measured by the BDI-II (depression score of 14 or more). In our study, significant improvements were demonstrated not only in sleep estimates but also in symptoms of depression. Assessment of co-morbidity may be of great importance following Jernelöv et al. (2012), who found that comorbidity was associated with a smaller improvement in insomnia severity.

Interestingly, while our unsupported intervention did not lead to a significant change in process variables such as psychological flexibility and mindfulness from pre to post, it significantly reduced the suppression of distressing thoughts (measured by WBSI). One explanation might be that mindfulness skills and psychological flexibility were already on a relatively high level at the beginning of the intervention (FFMQ; $M = 135.05$ for the iACT group; AAQ-II; $M = 17.45$ for the iACT group), leaving limited space for improvement. It is possible that the measures of AAQ-II and FFMQ do not discover the essential processes associated with insomnia, and instead, suppression of thoughts might be the primary focus. This is supported by the observations that rumination and worry might be central processes in insomnia, predicting increased sleep disturbance (McGowan, Behar & Luhmann, 2016; Sunhed & Jansson-Fröjmark, 2014). This points out the possibility that process measured associated with worry and rumination could be relevant when understanding insomnia. Clearly, further research is needed to clarify important psychological processes related to insomnia.

Attrition is considered a potential problem, particularly in Internet-delivered interventions (Zachariae et al., 2016). According to a recent meta-analysis of insomnia RCTs, dropout rates for self-help insomnia studies at post-treatment ranged from 0 to 44.4%, with an average of 14.5% (Ho, Chung, Yeung, Ng, Kwan, Yung, & Cheng, 2015). In this study, we found an average dropout rate of 5 % at post-measurement (iACT and WLC), and 9 % at follow-up for the treatment group (iACT) reflecting the adherence to the assessments; these are relatively low rates compared to the results in the above-mentioned meta-analyses. Although the adherence to the pre-, post- and follow-up assessments was relatively high, the adherence to the online program was lower. The self-reported data indicated that while 60% spent one hour or more weekly on the program, around 40% of the participants were not fully using the program. However, the adherence to the program might have been lower due to the use of a self-report measure. In the present study, no personal support was provided during the intervention, a factor that might be expected to lead to

low adherence. Instead, weekly e-mail-based reminders were used to increase adherence to the program (XXX, XXX, XXX, & XXX, 2014). The importance of reminders in Internet-delivered interventions should be explored in more depth. Further, more research is needed to clarify the number of usage hours that is needed for an online program to have a clinically significant impact.

The results obtained in this study are very much in line with effect sizes reported in other Internet-based intervention studies where no human support has been provided. For instance, Cuijpers et al. (2011a), who examined the effects of psychotherapy for adult depression, including Internet-based treatments, found that supported treatments yielded an effect size of $d = 0.61$ whereas unsupported treatments showed an effect size of $d = 0.25$. A meta-analysis by Cuijpers et al. (2011b) on self-guided psychological interventions for depression, indicated a mean effect size of $d = 0.28$, and at follow-up $d = 0.23$. We found small between-group effect sizes on symptom measures, ranging from 0.21 to 0.53 at post-measurement (mean $d = 0.37$).

Although it is important to promote adherence and target high efficacy, it is also important to investigate whether positive results can be achieved by offering less human support – although some level of contact with a clinician in self-help interventions is recommended (Manber, Simpson & Bootzin, 2015). Interventions that provide therapist support cost more, which reduces the ability to disseminate them to a larger audience. For this reason alone, wholly self-help interventions are needed. In our self-help intervention, about 80% were classified as having moderate or severe insomnia prior the intervention compared to about 40% at the follow-up. The follow-up figure could be a slight underestimation since the drop-outs were counted as no benefitted from the intervention.

Although these results are promising, the study has its limitations. First, the sample was recruited through a newspaper advertisement. This sample was motivated to participate, a factor which may have influenced the low drop-out rate. Second, the sample was also highly educated – the majority of all participants (60 %) had a university education – which may also

have impacted on the generalizability of the results. A further limitation is that, for comparison, we used a wait-list control group. We did not have a possibility to directly compare our treatment to other treatment modalities, such as self-help CBT-I. Therefore, future studies should include control groups receiving different types of intervention, including participants of different ages (adolescents, older adults) and from different populations. Non-inferiority trials comparing Internet-delivered ACT for sleep disturbances with face-to-face- or group-delivered ACT in different health care settings are also needed. Additionally, our findings are based only on sleep-related or psychological self-report measures, as we were not able to collect reliable sleep diary data. When investigating insomnia and sleeping difficulties, objective physiological measures such as actigraphy or polysomnographs would be required to confirm changes in sleep. Another limitation in our study is insufficient information on treatment adherence. It was based on self-reports and we were not able to collect adherence data. Such information would be essential to better understand adherence and attrition. Further, the investigated sample included also participants with subthreshold sleep disturbances (30% of the sample), and this fact needs to be observed when drawing conclusions.

In conclusion, this study including both subthreshold and clinical sleep disturbances, showed that Internet-delivered self-help based on Acceptance and Commitment Therapy was effective for the treatment of sleep disturbances when compared to a wait-list control condition. Furthermore, the results indicated that positive changes were maintained for the intervention group at the 6-month follow-up. Despite the positive outcomes, there is need and grounds for further improvement. In future studies, it would be important to assess whether an ACT-based insomnia treatment program of longer duration would produce better results in terms of larger effect sizes, and how much support would be needed to provide a “sufficient” level of support in insomnia interventions.

REFERENCES

- Åkerlund, R., Bolanowski, I., & Lundh, L. G. (2004). A pilot study of an ACT-inspired approach to the treatment of insomnia. Unpublished data.
- A-Tjak J. G., Davis, M. L., Morina, N., Powers, M. B., Smits, J. A., & Emmelkamp, P. M. (2015). A meta-analysis of the efficacy of acceptance and commitment therapy for clinically relevant mental and physical health problems. *Psychotherapy and Psychosomatics*, *84*, 30–36.
- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, *13*, 27–45.
- Baik, K. D., & O'Brien, W. H. (2013). Evaluating the acceptance and commitment therapy for insomnia: A single subject investigation of effectiveness. Under Review.
- Baik, K. D. (2015). Evaluating acceptance and commitment therapy for insomnia: a randomized controlled trial (2015). Doctoral thesis, the Graduate College of Bowling Green State University.
- Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine*, *2*, 297–307.
- Beck, A. T., Steer, R. A., & Brown, G. K. (2004). *BDI II - Beckin depressioasteikko. Käsikirja*. Helsinki: Psykologien Kustannus Oy.
- Blom, K., Tarkian Tillgren, H., Wiklund, T., Danlycke, E., Forssén, M., Söderström, A., Johansson, R., Hesser, H., Jernelöv, S., Lindefors, N., Andersson, G., & Kaldö, V. (2015). Internet- vs. group-delivered cognitive behavior therapy for insomnia: A randomized controlled non-inferiority trial. *Behavior Research and Therapy*, *70*, 47–55.
- Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., Waltz, T., & Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire - II: A revised measure of psychological flexibility and experiential avoidance. *Behavior Therapy*, *42*, 676–688.

- Buhrman, M., Skoglund, A., Husell, J., Bergström, K., Gordh, T., Hursti, T., Bendelin, N., Furmark, T., & Andersson, G. (2013). Guided internet-delivered acceptance and commitment therapy for chronic pain patients: a randomized controlled trial. *Behavior Research and Therapy*, 51(6), 307–315.
- Cuijpers, P., Andersson, G., Donker, T., & van Straten, A. (2011a). Psychological treatment of depression: Results of a series of meta-analyses. *Nordic Journal of Psychiatry*, 65, 354–364.
- Cuijpers, P., Donker, T., Johansson, R., Mohr, D. C., van Straten, A., & Andersson, G. (2011b). Self-guided psychological treatment for depressive symptoms: a meta-analysis. *PLoS ONE*, 6, e21274.
- Dahlin, M., Andersson, G., Magnusson, K., Johansson, T., Sjögren, J., Håkansson, A., Pettersson, M., Kadowaki, Å., Cuijpers, P., & Carlbring, P. (2016). Internet-delivered acceptance-based behaviour therapy for generalized anxiety disorder: A randomized controlled trial. *Behaviour Research and Therapy*, 77, 86–95.
- Dalrymple, K. L., Fiorentino, L., Politi, M. C., & Posner, D. (2010). Incorporating Principles from Acceptance and Commitment Therapy for Insomnia: A Case Example. *Journal of Contemporary Psychotherapy*, 40, 209–217.
- Feske, U., & Chambless, D. L. (1995). Cognitive behavioral versus exposure only treatment for social phobia: A meta-analysis. *Behavior Therapy*, 26, 695–720.
- French, K., Golijani-Moghaddam, N., & Schröder, T. (2017). What is the evidence for the efficacy or self-help acceptance and commitment therapy? A systematic review and meta-analysis. *Journal of Contextual Behavioral Science*, 6, 360–374.
- Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (2012). *Acceptance and commitment therapy: The process and practice of mindful change* (2nd edition). New York, NY: The Guilford Press.

- Hayes, S. C., Villatte, M., Levin, M., & Hildebrandt, M. (2011). Open, aware, and active: contextual approaches as an emerging trend in the behavioral and cognitive therapies. *Annual Review of Clinical Psychology, 7*, 141-168.
- Hesser, H., Gustafsson, T., Lundén, C., Henrikson, O., Fattahi, K., Johnsson, E., Westin, V. Z., Carlbring, P., Mäki-Torkko, E., Kaldø, V., & Andersson, G. (2012). A randomized controlled trial of internet-delivered cognitive behavior therapy and acceptance and commitment therapy in the treatment of tinnitus. *Journal of Consulting & Clinical Psychology, 80*, 649–661.
- Ho, F. Y.-Y., Chung, K.-F., Yeung, W.-F., Ng, T. , Kwan, K.-S., Yung, K.-P., & Cheng, S. K. (2015). Self-help cognitive behavioral therapy for insomnia: A meta-analysis of randomized controlled trials. *Sleep Medicine Reviews, 19*, 17–28.
- Holi, M., Sarnalllahti, P. R., & Aalberg, V. A. (1998). A Finnish validation study of SCL-90. *Acta Psychiatrica Scandinavica, 97*, 42–46.
- Jansson-Fröjmark, M., Harvey, A. G., Norell-Clarke, A., & Linton, S. J. (2012). Associations between psychological factors and nighttime/daytime symptomatology in insomnia. *Cognitive Behavior Therapy, 41*, 273–87.
- Jansson-Fröjmark, M., & Linton, S. J. (2006). Psychosocial work stressors in the development and maintenance of insomnia: A prospective study. *Journal of Occupational Health Psychology, 11*, 241–248.
- Jernelöv, S., Lekander, M., Blom, K., Rydh, S., Ljöttson, B., Axelsson, J., & Kaldø, V. (2012). Efficacy of a behavioral self-help treatment with or without therapist guidance for co-morbid and primary insomnia – a randomized controlled trial. *BMC Psychiatry, 12*(5).
- Jones, H. A., Heffner, J. L., Mercer, L., Wyszynski, C. M., Vilardaga, R., & Bricker, J. B. (2015). Web-based acceptance and commitment therapy smoking cessation treatment for smokers with depressive symptoms. *Journal of Dual Diagnosis, 11*, 56-62.

- Johansson, R., & Andersson, G. (2012) Internet-based psychological treatments for depression, *Expert Review of Neurotherapeutics*, 12(7), 861-870.
- Johns, M. W. (1991). A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *sleep*, 14, 540–545.
- Koffel, E. A., Koffel, J. B., & Gehrman, P. R. (2015). A meta-analysis of group cognitive behavioral therapy for insomnia. *Sleep Medicine Reviews*, 19, 6–16.
- Kyllönen, H. M., Muotka, J., Puolakanaho, A., Astikainen, P., Keinonen, K. & Lappalainen, R. (2018). A brief Acceptance and Commitment Therapy for depression: a randomized controlled trial with a 3-year follow-up for the intervention group. *Journal of Contextual Behavior Science*, 10, 55–63.
- Levin, M.E., Haeger, J., Pierce, B. & Twohig, M.P. (2017). Web-based acceptance and commitment therapy for mental health problems in college students: A randomized controlled trial. *Behavior Modification*, 41, 141-162.
- Levin M. E. , Hayes S. C., Pistorello, J., Seeley, J. R. (2016). Web-Based Self-Help For Preventing Mental Health Problems In Universities: Comparing Acceptance And Commitment Training To Mental Health Education. *Journal of Clinical Psychology*, 72(3), 207-25.
- Ljótsson, B., Atterlöf, E., Lagerlöf, M., Andersson, E., Jernelöv, S., Hedman, E., Kemani, M., & Wicksell, R. (2014). Internet-delivered acceptance and values-based exposure treatment for fibromyalgia: A pilot study. *Cognitive Behavior Therapy*, 43, 93–104.
- Mai, E., & Buysse, D. J. (2008). Insomnia: Prevalence, impact, pathogenesis, differential diagnosis, and evaluation. *Sleep Medicine Clinics*, 3, 167–174.
- Manber, R., Simpson, N. S., & Bootzin, R. R. (2015). A step towards stepped care: Delivery of CBT-I with reduced clinician time. *Sleep Medicine Reviews*, 19, 3–5.
- McGowan, S. K., Behar, E., & Luhmann, M. (2016). Examining the Relationship Between Worry and Sleep: A Daily Process Approach. *Behavior Therapy*, 47(4), 460–473.

- Moffitt, R., & Mohr, P. (2015). The efficacy of a self-managed acceptance and commitment therapy intervention DVD for physical activity initiation. *British Journal of Health Psychology, 20*, 115–129.
- Morin, C. M. (2004). Cognitive-behavioral approaches to the treatment of insomnia. *Journal of Clinical Psychiatry, 65*, 33–40.
- Morin, C. M., & Espie, C. A. (2003). *Insomnia: A clinical guide to assessment and treatment*. New York, NY, US: Kluwer Academic/Plenum Publishers, New York, NY.
- Morin, C.M., LeBlanc, M., Daley, M., Gregoire, J.P., & Mérette, C. (2006). Epidemiology of insomnia: prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. *Sleep Medicine, 7*, 123–130.
- Ojanen, M. (2001). Graafiset analogia-asteikot elämänlaadun ja hyvinvoinnin mittauksessa. In S. Talo (Ed.), *Toimintakyky – viitekehyksestä arviointiin ja mittaamiseen*. Turku: Kela.
- Ojanen, M., & Seppälä, H. (1996). *Assesment of psychosocial capabilities of persons with developmental disabilities*. Helsinki: Kehitysvammaliitto.
- Okajima, I., Komada, Y., & Inoue, Y. (2011). A meta-analysis on the treatment effectiveness of cognitive behavioral therapy for primary insomnia. *Sleep and Biological Rhythms, 9*, 24–34.
- Partinen, M., & Gislason, T. (1995). Basic Nordic Sleep Questionnaire (BNSQ): a quantitated measure of subjective sleep complaints. *Journal of Sleep Research, 4*, 150–155.
- Pigeon, W. R., & Perlis, M. L. (2008). Cognitive Behavioral Treatment of Insomnia. In W. O'Donohue, J. E. Fisher (Eds.), *Cognitive Behavior Therapy. Applying Empirically Supported Techniques in Your Practice* (pp. 283–295). Hoboken, New Jersey: John Wiley & Sons, Inc.
- Ruiz, F. J. (2010). A Review of Acceptance and Commitment Therapy (ACT) Empirical Evidence: Correlational, Experimental Psychopathology, Component and Outcome Studies. *International Journal of Psychology and Psychological Therapy, 10*, 125–162.

- Ruiz, F. J. (2012). Acceptance and commitment therapy versus traditional cognitive behavioral therapy: A systematic review and meta-analysis of current empirical evidence. *International Journal of Psychology and Psychological Therapy*, *12*, 333–358.
- Segal, D. L., Coolidge, F. L., Cahill, B. S., & O'Riley, A. A. (2008). Psychometric properties of the Beck Depression Inventory II (BDI-II) among community-dwelling older adults. *Behavior Modification*, *32*, 3–20.
- Sjögren, T., Nissinen, K. J., Järvenpää, S. K., Ojanen, M. T., Vanharanta, H., & Mälkiä, E. (2005). Effects of a workplace physical exercise intervention on the intensity of headache and neck and shoulder symptoms and upper extremity muscular strength of office workers: A cluster randomized controlled cross-over trial. *Pain*, *116*, 119–128.
- Sunnhed, R., & Jansson-Fröjmark, M. (2014). Are Changes in Worry Associated with Treatment Response in Cognitive Behavioral Therapy for Insomnia? *Cognitive Behaviour Therapy*, *43*, 1–11.
- Trompetter, H. R., Bohlmeijer, E. T., Veehof, M. M., & Schreurs, K. M. G. (2015). Internet-based guided self-help intervention for chronic pain based on Acceptance and Commitment Therapy: A randomized controlled trial. *Journal of Behavioral Medicine*, *38*, 66–80.
- van Mill, J. G., Hoogendijk, W. J. G., Vogelzangs, N., van Dyck, R., & Penninx, B. W. J. H. (2010). Insomnia and sleep duration in a large cohort of patients with major depressive disorder and anxiety disorders. *Journal of Clinical Psychiatry*, *71*, 239–246.
- van Straten, A., & Cuijpers, P. (2009). Self-help therapy for insomnia: A meta-analysis. *Sleep Medicine Reviews*, *13*, 61–71.
- Wegner, D. M., & Zanakos, S. (1994). Chronic thought suppression. *Journal of personality*, *62*, 615–640.

- Yuen, E. K., Herbert, J. D., Forman, E. M., Goetter, E. M., Comer, R., & Bradley, J. C. (2013). Treatment of social anxiety disorder using online virtual environments in Second Life. *Behavior Therapy, 44*, 51–61.
- Zachariae, R., Lyby, M. S., Ritterband, L. M., & O’Toole, M. S. (2016). Efficacy of internet-delivered cognitive-behavioral therapy for insomnia – A systematic review and meta-analysis of randomized controlled trials. *Sleep Medicine Reviews, 30*, 1–10.
- Zetterqvist, V., Grudin, R., Rickardsson, J., Wicksell, R. K., & Holmström, L. (2018) Acceptance-based behavioural treatment for insomnia in chronic pain: A clinical pilot study. *Journal of Contextual Behavioral Science, 9*, 72-79.

Table 1. Participant characteristics (N = 83).

Characteristics	iACT (n=43)	WLC (n=40)	All (n= 83)
Age <i>M (SD)</i>	56.05 (11.05)	50.78 (15.26)	53.51 (13.43)
Sex			
Females	32 (74.4 %)	21 (52.5 %)	53 (63.9 %)
Males	11 (25.6 %)	19 (47.5 %)	30 (36.1 %)
Education*			
High	26 (60.5 %)	24 (55.80 %)	50 (60.2 %)
Middle	16 (37.2 %)	14 (32.50 %)	30 (36.1 %)
Low	1 (2.3 %)	2 (4.7 %)	3 (3.6 %)
Marital status			
Single or divorced	6 (14.0 %)	8 (18.60 %)	14 (16.8 %)
Married or living together	37 (86.1 %)	32 (74,4 %)	69 (83.1 %)
Employment			
Employed	21 (48.8 %)	21 (48.8 %)	42 (50.6 %)
Unemployed	2 (4.7 %)	3 (7.0 %)	5 (6 %)
Retired	15 (34.9 %)	12 (27.9 %)	27 (32.5 %)
Others**	5 (11.6 %)	4 (9.3 %)	9 (10.8 %)
Sleep medication			
Currently	21 (48.8 %)	16 (40 %)	37 (44.6 %)
No medication	22 (51.2 %)	24 (60 %)	46 (55.4 %)
Treatment for sleep			
Earlier treatment	15 (34.9 %)	14 (35 %)	29 (34.9 %)
No treatment	28 (65.1 %)	26 (65 %)	54 (65.1 %)
Insomnia Severity Index (ISI), <i>M (pre)</i>	17.74 (4.07)	16.13 (4.06)	16.96 (4.12)
Subthreshold insomnia	9 (20.9 %)	15 (37.5 %)	24 (28.9 %)
Moderate insomnia	26 (60.5 %)	20 (50 %)	46 (55.4 %)
Severe insomnia	8 (18.6 %)	5 (12.5 %)	13 (15.7 %)
Severity of depressive symptoms (BDI-II), <i>M</i>	12.16 (6.57)	12.38 (9.22)	12.27 (7.91)
No depression (<14)	26 (60,5%)	28 (70%)	54 (65.1%)
Mild	12 (27.9%)	7 (17.5%)	19 (22.9%)
Moderate	4 (9.3%)	3 (7.5%)	7 (8.4%)
Severe	1 (2.3%)	2 (5%)	3 (3.6%)

Education*: High: more than 12 years, Middle: 9- 12 years, Low: less than 9 years

Others**: students, on sick leave, home makers

Table 2. Weekly overview over the self-help Internet program for sleep disturbances

Week	Theme of the week	Exercises
Week 1	<p>Introduction</p> <p>Theme of the week: Broaden your horizon</p> <p>Values and value-based actions. Identifying what matters the most in your life and acting accordingly.</p>	<p>2 video clips: Values, Wise actions (value-based actions)</p> <p>Audio: Mindfulness of Breathing</p>
Week 2	<p>Theme of the week: Present moment</p> <p>Mindfully notice your internal and external experiences, notice the movement of your breath. Live in the present moment.</p>	<p>Video clip: Mindfulness</p> <p>Audio: Mindful Breathing, Mindful Listening, Mindful Sitting</p>
Week 3	<p>Theme of the week: Cognitive defusion</p> <p>The power of thoughts. Identify your unwanted thoughts and emotions and learn to describe, name and welcome them.</p>	<p>Video clip: Wise mind</p> <p>Audio: Observing the Stream of Thoughts, Labeling Thoughts</p>
Week 4	<p>Theme of the week: The observer's stance</p> <p>Learn to view your thoughts and emotions from an observer's stance.</p>	<p>Video clip: Observing</p> <p>Audio: Observer exercise</p>
Week 5	<p>Theme of the week: Toward an attitude of acceptance</p> <p>Let go of your struggle and learn acceptance towards your wakefulness and unwanted thoughts</p>	<p>Video clip: Acceptance</p> <p>Audio: Scanner, A Stone on the Beach, An Uninvited Guest</p>
Week 6	<p>Theme of the week: Summary of the program</p> <p>What have you learnt? Plans for the future</p>	<p>Audio: Body Meditation</p>

Table 3. Estimated mean values and standard deviation for symptoms measures at Pre, Post (iACT and WLC), and at Follow-up (iACT group only).

Out-come	Group	Pre M (SD)	Post M (SD)	F-up M (SD)	Pre-Post change d between group Wald test (df=1) p-value	Pre, Post, F-up Change d within group Wald test (df=2) p-value
BNSQ	iACT	21.77 (4.45)	19.91 (5.25)	18.35 (5.42)	d = 0.42 W = 6.71	d = 0.69 W = 32.23
	WLC	21.65 (4.07)	21.57 (4.45)	x	p = 0.001	p < 0.001
ESS	iACT	6.85 (4.59)	5.67 (3.81)	5.20 (3.22)	d = 0.21 W = 1.49	d = 0.42 W = 15.04
	WLC	7.60 (4.28)	7.30 (5.09)	x	p = 0.222	p < 0.001
DBAS	iACT	96.33 (22.81)	86.57 (25.74)	77.47 (29.70)	d = 0.53 W = 10.41	d = 0.71 W = 34.86
	WLC	87.93 (20.62)	89.55 (18.85)	x	p = 0.001	p < 0.001
BDI-II	iACT	12.16 (6.50)	8.02 (6.59)	8.48 (7.86)	d = 0.47 W = 12.42	d = 0.51 W = 23.86
	WLC	12.38 (9.44)	11.91 (9.57)	x	p < 0.001	p < 0.001
SCL-90	iACT	0.60 (0.33)	0.41 (0.36)	0.42 (0.31)	d = 0.30 W = 3.25	d = 0.55 W = 18.49
	WLC	0.65 (0.52)	0.59 (0.54)	x	p = 0.072	p < 0.001
Satis- faction	iACT	62.56 (17.60)	68.11 (17.60)	67.95 (15.75)	d = 0.23 W = 2.49	d = 0.32 W = 12.09
	WLC	63.30 (17.38)	64.86 (18.49)	x	p = 0.115	p = 0.002

BNSQ = The Basic Nordic Sleep Questionnaire; ESS = The Epworth Sleeping Scale; DBAS = The Dysfunctional Beliefs and Attitudes about Sleep Scale; BDI-II = The Beck Depression Inventory; SCL-90 = The Symptom Checklist 90 (the mean value across all items is reported); Satisfaction = The Finnish Descriptive Visual Rating Scale, life satisfaction.

Pre-Post change: Between group effect size (d) at post, and Wald-test (W) and p-value testing whether groups changed differently from Pre to Post.

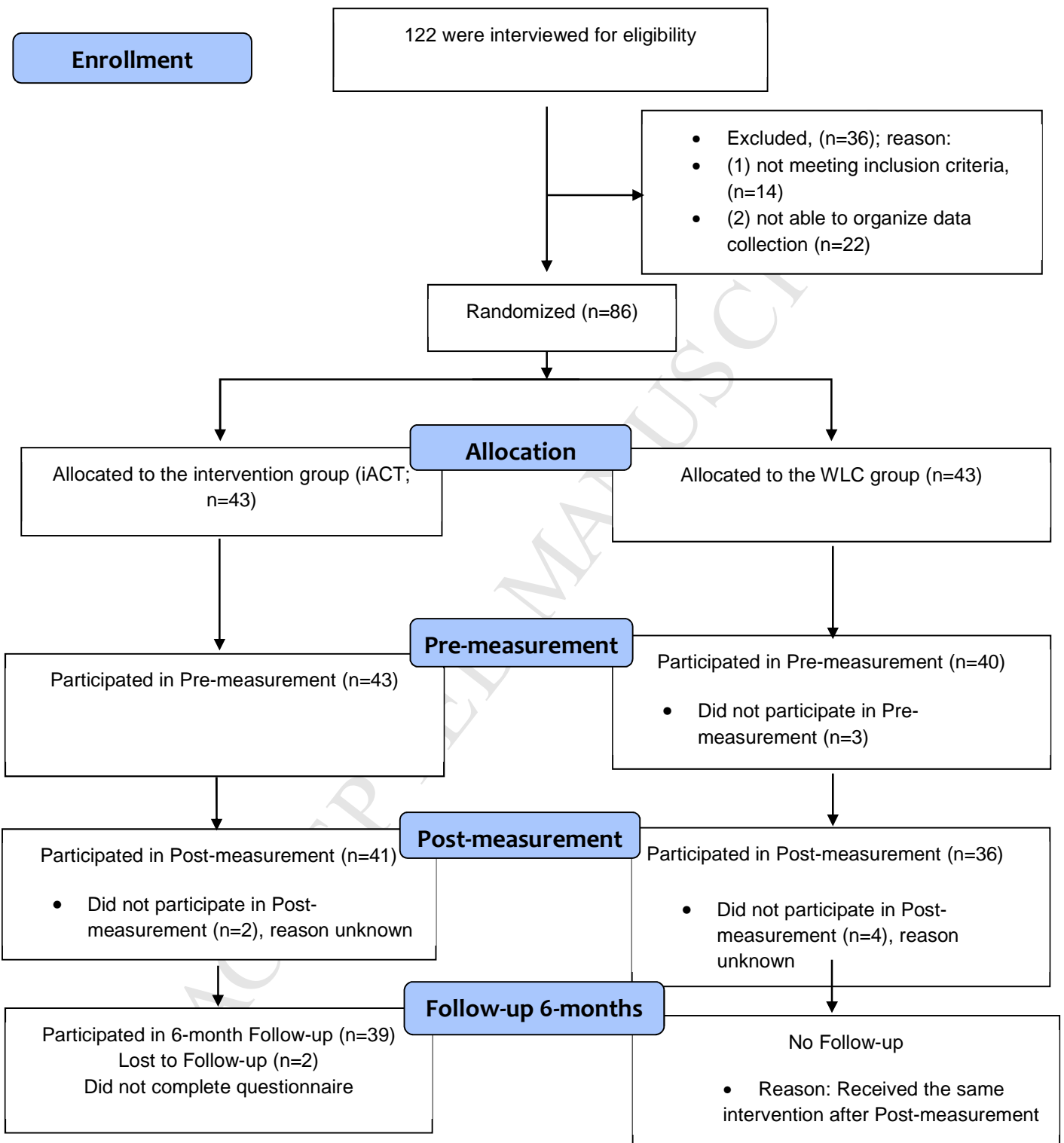
Pre, Post, F-up Change: Within group effect size (d) from Pre to F-up, and Wald-test (W) and p-value testing whether the iACT group changed significantly over time (Pre, Post, Follow-up).

Table 4. Estimated mean values and standard deviation for process measures at Pre, Post (iACT and WLC), and at Follow-up (iACT group only).

Out- come	Group	Pre M (SD)	Post M (SD)	F-up M (SD)	Pre-Post Change* d between group Wald test (df=1) P-value	Pre, Post, F- up Change d within group Wald test (df=2) P-value
AAQ-II	iACT	17.42 (8.95)	15.89 (8.31)	15.39 (8.93)	d = 0.01 W = 0.81	d = 0.23 W = 3.24
	WLC	18.10 (9.15)	16.62 (11.17)	x	p = 0.368	p = 0.198
WBSI	iACT	44.65 (11.80))	39.85 (12.85)	39.01 (14.76)	d = 0.30 W = 3.93	d = 0.42 W = 18.64
	WLC	44.85 (13.68)	43.78 (14.06)	x	p = 0.047	p = 0.0001
FFMQ	iACT	134.79 (15.50)	137.39 (17.03)	138.73 (18.27)	d = 0.10 W = 0.33	d = 0.23 W = 2.74
xxx	WLC	131.23 (18.93)	132.07 (19.65)	x	p = 0.568	p = 0.254

AAQ-II = Acceptance and Action Questionnaire; WBSI = White Bear Suppression Inventory; FFMQ (total) = Five Facet Mindfulness Questionnaire.

Participant flow diagram



Highlights

- Internet-delivered self-help ACT improved quality and duration of sleep
- Positive impact was observed in dysfunctional beliefs and attitudes about sleep
- At 6-month follow-up, results were maintained
- Internet-delivered self-help ACT may be effective for sleep disturbances