

Online Treatment of Insomnia using Behavioral Techniques

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Introduction

Chronic insomnia can have a large impact on daily life. Problems with the initiation or maintenance of sleep are associated with difficulties in daily functioning. Daytime complaints include sleepiness, fatigue, concentration problems and impaired performance. As insomnia is one of the most prevalent psychological health problems affecting between 9% and 19% of the adult population, it also has a socioeconomic impact on society in general. Walsh and Engelhardt¹ estimated the direct costs involved in the diagnosis and treatment of insomnia in 1995 in the USA as \$14 billion. Indirect costs of insomnia may involve the loss of productivity and the occurrence of accidents. Insomniacs have a higher sick absence than people not troubled by insomnia^{2,3} and are, in addition, more prone to work accidents.^{4,3} A considerable part of traffic accidents are directly related to drowsy driving and an even larger proportion of drivers admit to have driven a car while sleepy.⁵ Although the prevalence of insomnia is high, less than 50% mention their problem to health care professionals.⁶ Patients often believe that their insomnia problem will resolve on its own. Frequently these patients also believe that they should be able to manage their sleep problem without professional help. This attitude may explain the considerable usage of over-the-counter medication in insomnia sufferers.^{7,8}

Treatment of Insomnia

The main complaint in insomnia is a problem to fall asleep and/or to wake up during the night and not being able to resume sleep again. This has led to the development of pharmacotherapy aimed at sedative as well as anti-anxiolytic actions. The progress in the pharmacotherapy of insomnia over the last four decades have improved the hypnotic compounds in terms of a reduction of negative effects on the physiological sleep pattern and a reduction of side effects. Although sleep medication has shown to be effective in the acute management of insomnia, a meta-analytical study of the NIH concludes that this effect does not persist beyond the termination of the treatment.⁷

Primary care physicians tend to choose for pharmacological treatment of insomnia,⁹ although Cognitive Behavioral Therapy for Insomnia (CBT-I) has been recognized as an effective alternative,^{7,10} causing a durable long-term improvement of the patient's sleep, well beyond the termination of the treatment. The efficacy of Cognitive Behavioral Therapy has been established for primary insomnia and more recently there is growing evidence for the efficacy of CBT-I for secondary insomnia as well.^{11,12} When insomnia patients were asked to rate their acceptability of either pharmacotherapy or CBT-I they significantly preferred CBT-I over pharmacotherapy.^{13,9} Only a small percentage, however, actually get the therapy.

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Cognitive Behavioral Therapy of Insomnia

Several models have been proposed to understand the development of chronic insomnia.^{14,15,16} Despite differences between the models, common aspects are a reciprocal interaction between nervous system arousal, cognitive and emotional activation, environmental aspects, dysfunctional cognitions and maladaptive behavior. It is not surprising that pharmacotherapy is not an effective long-term solution for several of these components and their interaction. Cognitive behavioral therapy for insomnia (CBT-I) consists of a combination of several techniques addressing the various aspects of the development of chronic insomnia. The NIH concludes in their state-of-the-science conference in 2005⁷ that such a combination of techniques can stay effective even after the termination of the treatment. The most important techniques used are: sleep restriction, stimulus control, cognitive therapy, sleep hygiene and relaxation techniques. The AASM practice parameters¹⁷ support the efficacy of the techniques for the treatment of insomnia. A combination of the techniques is more effective than applying the techniques separately.

As the majority of insomniacs develop an irregular sleep pattern the first concern in CBT-I is to encourage patients to keep regular bedtimes and times of getting up. Also other aspects of healthy sleep hygiene are covered. Some education about sleep and the role of the biological clock is essential to motivate the patients to change their habits. The rationale of the sleep restriction technique is to increase sleep time by consolidating the fragmented sleep of insomniacs in one solid block and by reducing the time the patient is awake in bed. The negative conditioning between sleep stimuli (e.g. the sleeping room) and actual sleep is a serious problem in a large proportion of insomnia patients. Stimulus control aims to restore the positive association between these aspects, so that the sleeping room is associated again with sleep instead of sleepiness. Cognitive techniques are meant to challenge maladaptive behavior and thoughts patients may have developed over time to cope with the consequences of their poor sleep and replace them with sleep-positive ones. Finally, depending on the specific problems, relaxation techniques can be offered to facilitate the process of falling asleep. Several of these behavioral techniques have been used extensively since the early 1970s.

Cognitive Behavioral Therapy of Insomnia over the Internet

Standard CBT-I is delivered in a face-to-face situation, generally by mental health care practitioners or physicians trained in sleep medicine. This is a time consuming procedure and worldwide the availability of therapists able to deliver CBT-I is scarce. A promising alternative for the standard face-to-face delivery of the therapy is the internet. The advantage of CBT for insomnia over the internet is the fact that that the therapy can be followed at home, so that it is independent of location. When the internet is chosen as medium for the delivery of the

therapy the easiest way is to use self-help methods delivering CBT-I in a standardized way, but without a real therapist responding to the individual problems of a patient. Self-help methods with books, telephone and internet have been shown to be effective to treat insomnia.^{18,19} However, motivation of the patient is important to help overcome difficulties and to prevent drop-out.

With that in mind a web-based system Somnio was developed for the evaluation, diagnosis and treatment of insomnia patients. This paper reports on our experience with the internet based method and on the effectiveness of online CBT-I for a subgroup of 62 verified insomnia patients.

Methods

Prevalence of Symptoms and Sleep Profile

Approximately 50000 individuals visited the internet site www.somnio.eu. A posthoc exploration of these data showed that 19935 individuals (65.5% F and 34.5% M), thought they might have sleep problems and completed a 15 question self test for the assessment of their sleep problems. The 15 questions covered the major symptoms of insomnia, apnea, narcolepsy and limb movement disorders. In addition 5594 visitors completed a sleep interview to profile their sleep in details.

Cognitive Aspects

111 Patients (79 females, 32 males, 18 – 74 years), selected from those who entered the CBT-I therapy program, completed a questionnaire to assess faulty beliefs and negative attitude consisting of 21 items.^{14,21} Responses were collected on a 5-point scale ranging between fully agree to fully disagree. The chi-square non-parametric test was performed to test the hypothesis that all subjects will respond with negative attitudes and beliefs.

CBT-I Treatment

From this group 62 patients completed at least 7 of the 8 CBT treatment sessions (20 males, 42 females, age between 18 and 72 years). The patients presented various insomnia symptoms. Most patients (41.9%) showed a combination of problems concerning initiation and maintenance of sleep. 30.6% of the patients complained of problems with the initiation of sleep an 27.5% had problems with the maintenance of sleep. Patients with current, not-stable psychiatric comorbidities were excluded from the analysis.

The treatment plan consisted of 7 sessions with various components of CBT: sleep restriction, stimulus control, cognitive therapy, sleep hygiene and relaxation. An 8th session was used to summarize all techniques and tips. For each session, the patients had to keep a diary of their sleep wake schedule and their subjective perception of sleep. After each week this information was analyzed and a personalized treatment plan was proposed. Patients were also encouraged to send their personal comments and questions that were handled confidentially by a CBT therapist. In the first consult each patient was asked to specify their desired sleep pattern by the end of the treatment. The values of the sleep parameters in the first consult was considered as baseline values.

The effectiveness of the online CBT was assessed by self-reported sleep quality and feeling in the morning (measured on a 5 point rating scale), Total Sleep Time (TST) sleep efficiency, sleep latency, number of awakenings and minutes awake after

sleep onset (WASO). The overall improvement over the consecutive consults was tested with a repeated measures multivariate test. In addition the improvement after the 7th consult was compared to the baseline values of the first week, using the non-parametric Wilcoxon signed rank test. The improvement achieved after the 7th week was also compared to the desired improvement, specified in the first consult.

Results

Prevalence of Symptoms and Sleep Profile

The distribution of sleep problems in the sample of 19935 visitors was as follows: insomnia: 14%, apnea: 4.4%, narcolepsy: 3.2% and 1.7% limb movement disorder. 76.9% reported no sleep problems or reported only isolated symptoms. In this sample except in the apnea group, in the other 3 sleep problem groups there were more women than men. Interesting was that 70% of the apnea group reported insomnia as comorbidity.

The group of 5594 visitors who completed a detailed sleep profile questionnaire showed a large variability in sleep variables. Their average sleep latency was 67 minutes (standard deviation: 71.7), they were on average 91 minutes awake after sleep onset (standard deviation: 105.3) and they estimated that they were on average 79 minutes awake too early (standard deviation: 79.9). 37% of the visitors reported that they were taking sleep medication, whereas 24% mentioned taking alcohol as a night cap.

The sleep pattern in the apnea group without insomnia as comorbidity was different from the sleep pattern in the insomnia group. Interestingly the sleep pattern in the apnea group with comorbid insomnia was more similar to the sleep pattern of the insomnia group (Figure 1). Sleep latency, minutes awake after sleep onset, number of minutes waking up too early and minutes awake before getting up after last awakening were significantly different between the apnea and the insomnia group (Wilcoxon signed rank test, all values $p < 0.05$). When comparing the insomnia group with the comorbid apnea/insomnia group only sleep latency and minutes wake in bed after last awakening remained significantly different.

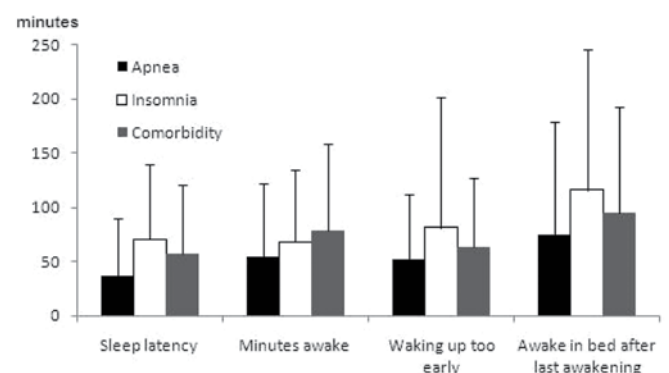


Fig. 1. Mean sleep pattern parameters of the apnea, insomnia and apnea/insomnia comorbidity group.

Cognitive Dysfunctioning

Before they entered the therapy the patients were asked to complete a questionnaire to assess faulty beliefs and negative attitudes. An overview of the answers on this questionnaire form the basis for the cognitive component of the CBT-I. In 7 statements there were significantly more agreements with

the expected response (chi-square test, all values $p < 0.001$). In 4 statements there was no difference in the distribution of responses over the 5 response classes. Strikingly, on 10 statements the subjects responded in a direction opposite to the expectations chi-square test, all values ($p < 0.001$).

Subjects agreed with statements concerning the positive effect of hypnotics and alcohol as sleeping aids ($p < 0.001$). Staying in bed longer after a poor night of sleep was considered to be good, although 8 hrs sleep was not a 'must' ($p < 0.001$). The subjects did show concern that their sleep was getting worse and that it would cause a nervous breakdown ($p < 0.001$, $p < 0.01$ respectively). However, they did not agree with statements that were more concerned with possible detrimental effects of their insomnia on daytime functioning, and with negative effects of the insomnia on their future ($p < 0.001$). The responses on the statement the positive effect of taking naps were equally divided over 'Agree' and 'Disagree' categories.

Effectiveness of the Therapy

To analyze the change in the sleep parameters over the consecutive 7 consults of the CBT-I a multivariate repeated measures analysis was performed with the sleep parameters Sleep latency, Wake after sleep onset (WASO), Total sleep time (TST), Sleep efficiency, Sleep quality and Feeling in the morning. The sleep parameters improved significantly ($F(1,6) = 3.31$, $p = 0.000$) over the consecutive consults. Sleep latency and Total sleep time did not contribute significantly to the overall

improvement over the consults. The variability in type of complaints of the patients may have been the cause that these parameters failed to reach significance. In the next section specific effects of the treatment is shown on subgroups with a specific type of complaint.

A comparison (Wilcoxon signed ranked test) of the values of the subjective sleep parameters in the 7th consult with the baseline values of the first consult showed that all sleep parameters improved significantly (Table 1). Bonferroni corrections were applied to correct for multiple comparisons.

The mean values of the most important sleep parameters are shown in Figure 2. The effect sizes (Cohen's d) ranged from moderate to moderately high (0.35 to 0.75).

Table 1. Z- and Significance Values of Sleep Parameters at Baseline and at the End of the Treatment

Sleep Parameter	Wilcoxon z-Value	Significance
Sleep efficiency	-6.03	$p < 0.000$
Time in bed	-5.44	$p < 0.000$
Total sleep time	-4.0	$p < 0.000$
Sleep latency	-4.33	$p < 0.000$
Number of Awakenings	-3.96	$p < 0.000$
Wake after sleep onset	-4.15	$p < 0.000$
Sleep quality	-2.21	$p < 0.05$
Feeling in the morning	-3.79	$p < 0.000$

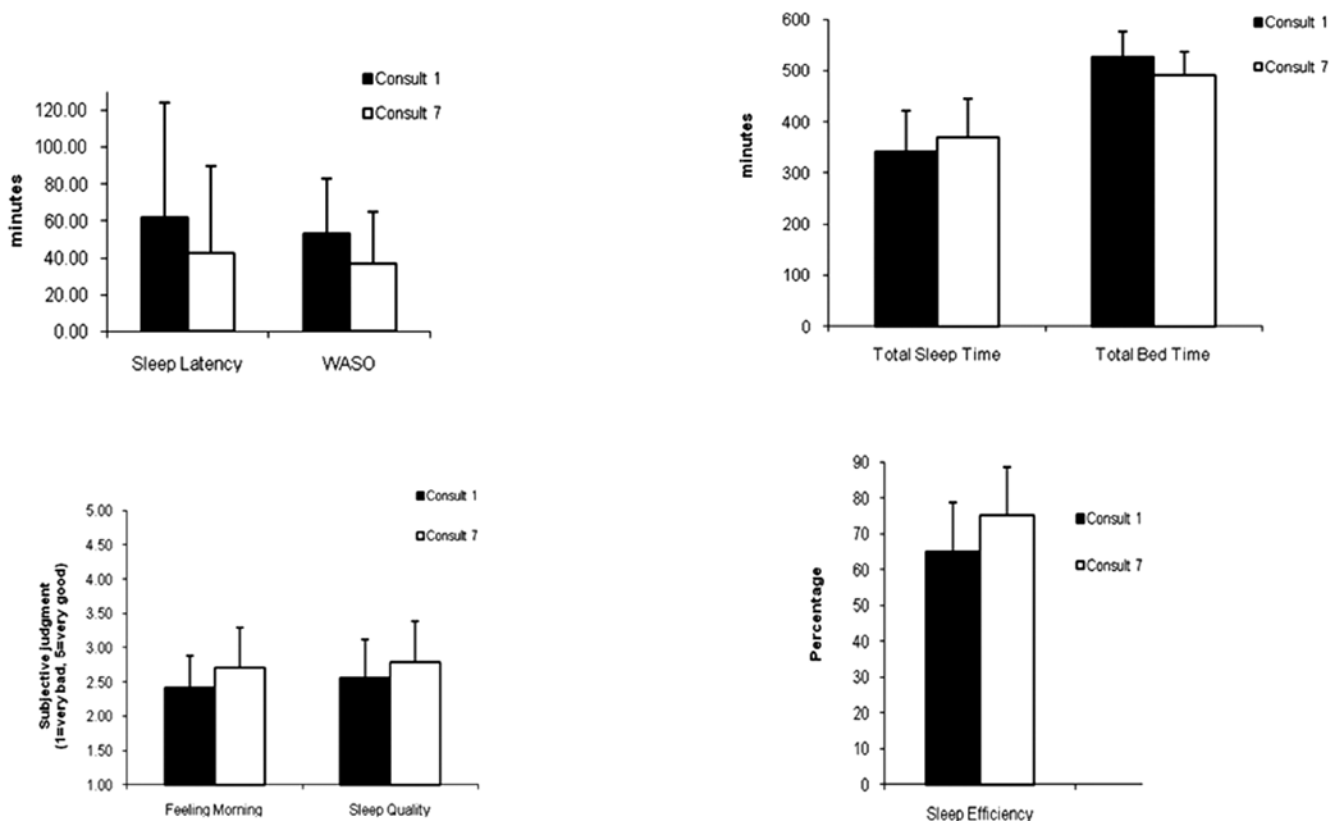


Fig. 2. Sleep parameters in the 1st consult (baseline) and the 7th consult

Specificity of the Therapy for Different Types of Complaints

Insomniacs have different types of complaints and generally one of the complaints is predominant. A good therapy should have a specific effect for the complaint types. This was tested by classifying the patients in three groups: initiating sleep, maintaining sleep or a combination of both symptoms on the basis of their initial sleep profile. The three groups were compared on the change in sleep parameters from baseline to the end of the treatment.

Sleep efficiency improved significantly ($p < 0.001$) in all three symptom groups ($z = -3.26, -3.15$ and -3.92 respectively). The improvement in total sleep time showed a trend in the sleep maintenance and the combination group ($z = -2.58, z = -2.98$ respectively, $p < 0.01$). Although all groups showed clear improvements in sleep latency, this improvement was only significant in the group with sleep initiating problems ($p < 0.002$). The minutes awake after sleep onset (WASO) also decreased in all groups, but the improvement was significant ($z = -3.39, p < 0.0008$) only for the group with WASO as primary complaint (sleep maintenance group). Interestingly, feeling in the morning improved significantly only in the combined symptom group ($z = -3.64, p < 0.0003$). Similarly, sleep quality improvement showed a trend towards significance only in the combined symptom group ($z = -2.71, p < 0.007$). Bonferroni correction was applied to correct for multiple comparisons.

The sizes of the treatment effects in all three groups ranged from moderate to high (Cohen's d between 0.39 to 2.14). This clearly shows that the protocol and personalization is effective.

Discussion

Prevalence of Symptoms and Sleep Profile

A high prevalence was found in apnea patients of insomnia as comorbidity. This high prevalence is in agreement with what is found in the literature^{22,23} and may warrant more emphasis on the assessment of insomnia in apnea diagnosis.

Cognitive Dysfunctioning

In the group of patients who completed the faulty beliefs and attitude questionnaire an interesting result was found. Although many patients said that they wanted to be able to get rid of their sleep medication, still sleep medication was considered to be the only solution to their sleep problem. Also taking a night cap as sleeping aid was considered to be a useful alternative. This was even more striking considering the fact that these patients had already chosen for cognitive behavioral therapy as solution for their sleep problem. The result that the responses to some of the statements were contrary to the expectation could be due to the fact that these patients were actively seeking help for their sleeping problem, so that they might have had a positive approach to some of the issues raised in the questionnaire.

Effectiveness of the Therapy

The improvements on the subjective sleep parameters were comparable to the effects of face-to-face CBT-I reported in the literature.^{24,9} For example the improvement in sleep efficiency was 17.1% in the Edinger study,²⁴ 24.3% in the Morin study⁹ and 15.5% in the present study. Total sleep time improved with 6.9% in the Edinger study,²⁴ 9.5% in the Morin study⁹ and 7.7% in the present study. The effect sizes (Cohen's d)

in this study ranged from moderate to moderately high. This is comparable to the values found in some recent studies on online self-administered insomnia treatment.^{19,20} These effects were found even though the patient group in this study consisted of patients with various insomnia complaints. When the original complaints of the patients were taken into account the effect sizes increased to very high. Most studies publish results of homogeneous and selected patient groups. The results in the present study shows effects of the treatment of a heterogeneous patient population comparable to real life situation.

Supportive contact of the consultant with the patients proved especially important to motivate them to adhere to the sleep restriction assignment. This component is generally considered to be the most difficult technique to do, but it is also found to be one of the most effective ones. Encouragement and making the patients understand why a specific assignment was important to do are crucial for the motivation. The importance of supportive contact with the patients was also shown in self-help studies on psychiatric problems.^{25,26}

Conclusions

In this paper we showed that the prevalence of insomnia and comorbidities measured via internet is comparable to other studies. The high percentage of comorbidity of insomnia in apnea patients should be of concern to the sleep centers to also focus on insomnia.

The prevalence of insomnia is very high and sleep centers have not been able to offer effective treatment because CBT-I is difficult to offer. In this paper we showed that with modern technology it is possible to offer the treatment cost-effectively. The internet based method of CBT treatment of insomnia patients is effective and easy to deliver. The knowledge based approach provides an ideal combination of a standard procedure and yet is completely individualized to the situation of the subject.

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